TECHNOLOGICAL MUSEUM AND TECHNICAL COLLEGE, SYDNEY N.S.W.

1905.

LEGISLATIVE ASSEMBLY.

NEW SOUTH WALES.

COMMISSION ON PRIMARY, SECONDARY, TECHNICAL, AND OTHER BRANCHES OF EDUCATION.

REPORT

OF THE

COMMISSIONERS

ON

AGRICULTURAL, COMMERCIAL, INDUSTRIAL,

AND OTHER FORMS OF

TECHNICAL EDUCATION,

CONTAINING THE

SUMMARISED REPORTS, WITH CONCLUSIONS AND RECOMMENDATIONS, ETC.

AND THE

EXTENDED REPORT OF THE COMMISSIONERS;

WITH ILLUSTRATIONS, ETC.

Printed under No. 13 Report from Printing Committee, 28 September, 1905.

SYDNEY: WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER.

1905.

50985 *3—*a* [17*s*. 6*d*.]

By His Excellency The Honourable SIR FREDERICK MATTHEW DARLEY, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Lieutenant-Governor of the State of New South Wales and its Dependencies, in the Commonwealth of Australia.

To

GEORGE HANDLEY KNIBBS, Esquire, F.R.A.S., of Sydney, in the State of New South Wales,—

Greeting:—

KNOW you, That reposing great trust and confidence in your zeal, discretion, and integrity, I, SIR FREDERICK MATTHEW DARLEY, as Lieutenant-Governor of the State of New South Wales, with the advice of the Executive Council thereof, do, by these presents, appoint you, the said GEORGE HANDLEY KNIBBS, Esquire, F.R.A.S., in conjunction with JOHN WILLIAM TURNER, Esquire, to proceed to Europe and America for the purpose of inquiring into existing methods of instruction in connection with primary, secondary, technical, and other branches of education, and of recommending for adoption whatever improvements you may consider might with advantage be introduced into the State of New South Wales.

Initd.—J.M.G.

(L.S.) Given under my Hand and the Public Seal of the State, at Sydney, in New South Wales aforesaid, this tenth day of April, in the year of Our Lord one thousand nine hundred and two, and in the second year of His Majesty's reign.

FREDK. M. DARLEY,
Lieutenant-Governor.

By His Excellency's Command,
JOHN SEE.

Entered on Record by me, in REGISTER OF PATENTS, No. 24, page 29, this eleventh day of April, one thousand nine hundred and two.

For the Colonial Secretary and Registrar of Records,
CRITCHETT WALKER,
Principal Under Secretary.

By His Excellency The Honourable SIR FREDERICK MATTHEW DARLEY, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Lieutenant-Governor of the State of New South Wales and its Dependencies, in the Commonwealth of Australia.

To

JOHN WILLIAM TURNER, Esquire, of Sydney, in the State of New South Wales,—

Greeting:—

KNOW you, That reposing great trust and confidence in your zeal, discretion, and integrity, I, SIR FREDERICK MATTHEW DARLEY, as Lieutenant-Governor of the State of New South Wales, with the advice of the Executive Council thereof, do, by these presents, appoint you, the said JOHN WILLIAM TURNER, Esquire, in conjunction with GEORGE HANDLEY KNIBBS, Esquire, F.R.A.S., to proceed to Europe and America for the purpose of inquiring into existing methods of instruction in connection with primary, secondary, technical, and other branches of education, and of recommending for adoption whatever improvements you may consider might with advantage be introduced into the State of New South Wales.

Initd.—J.M.G.

(L.S.) Given under my Hand and the Public Seal of the State, at Sydney, in New South Wales aforesaid, this tenth day of April, in the year of Our Lord one thousand nine hundred and two, and in the second year of His Majesty's reign.

FREDK. M. DARLEY,
Lieutenant-Governor.

By His Excellency's Command,
JOHN SEE.

Entered on Record by me, in REGISTER OF PATENTS, No. 24, page 28, this eleventh day of April, one thousand nine hundred and two.

For the Colonial Secretary and Registrar of Records,
CRITCHETT WALKER,
Principal Under Secretary.

1905.

LEGISLATIVE ASSEMBLY.

NEW SOUTH WALES.

COMMISSION ON PRIMARY, SECONDARY, TECHNICAL, AND OTHER BRANCHES OF EDUCATION.

REPORT OF THE COMMISSIONERS

ON

AGRICULTURAL, COMMERCIAL, INDUSTRIAL, AND OTHER FORMS OF TECHNICAL EDUCATION.

To His Excellency SIR HARRY HOLDSWORTH RAWSON, Admiral in the Royal Navy, Knight Commander of the Most Honourable Order of the Bath, Governor of New South Wales and its Dependencies, in the Commonwealth of Australia.

MAY IT PLEASE YOUR EXCELLENCY,—

We, your Commissioners, appointed on the 11th day of April, 1902, to proceed to Europe and America for the purpose of inquiring into existing methods of instruction in connection with primary, secondary, technical, and other branches of Education, and of recommending for adoption whatever improvements might with advantage be introduced into the State of New South Wales, have now the honour, in continuation of our Commission, to submit for your Excellency's acceptance a report on Agricultural, Commercial, Industrial, and other forms of Techical Education.

Your Commissioners left Sydney on 12th April, 1902, and returned on 23rd February, 1903, having travelled through the United Kingdom, France, Switzerland, Italy, Germany, Belgium, Holland, Denmark, Norway, Sweden, Finland, Russia, Bohemia, Austria, Hungary, the United States and Canada, visiting various educational institutions and conferring with distinguished educationists.

May we be permitted to remind your Excellency that the former reports under our commission are the following, viz.:—

(1) Interim Report on certain parts of Primary Education. Presented 3rd December, 1903.

(2) Report mainly on Secondary Education. Presented 6th October, 1904.

(3) Preliminary Report on Technical Education generally. Presented 19th December, 1904.

In submitting this our further Report for your Excellency's acceptance, it ought to be stated that, in the matter of Industrial Education alone, the work seen, and the information collected, was an *embarras de richesse.* To adequately describe the development of this type of education, as it was exhibited in the

various

various countries visited by your Commissioners, referring at the same time to the elementary, scientific and technical instruction immediately connected therewith, would itself occupy a far larger volume than the present one.

To the subject of schools for manual instruction and continuation schools, and their equipments, an equally large volume might be devoted. The same remark applies to the various systems of commercial education, and, also, to those of agricultural education.

Although in the main this Report is restricted to the description of those educational subjects, or branches of education, which are of immediate interest or of pressing importance, it advisedly refers, also, to matters which cannot be included in such a category. This procedure is not useless, for it serves to shew the wealth of the provision for technical education in various countries. At the same time, it offers some guide for future development of such education in this State.

The immediate object of the Report is threefold, for it proposes to do the following things, viz. :—

(i) To give an account of the various forms of technical education in other parts of the world.

(ii) To disclose what may be called the status of our effort in the matter of technical education, by affording the necessary material for a wide comparison.

(iii) To make clear, by such disclosure, what ought to be the normal aim and path of technical progress from the standpoint of national education, continually keeping in view, however, the urgency of local or particular needs.

The "Preliminary Report of the Commissioners on Agricultural, Commercial, Industrial and Technical Education generally, dated 19th December, 1904, pp. 1–29, may be read in connection herewith.

Neither Commissioner was able in the very limited time at his disposal—and considering the magnitude of the task—to cover the entire field; nor was it necessary. Each Commissioner consequently undertook only a portion of the task, endeavouring at the same time to make the work, as far as it was possible, supplementary to that of his colleague.

A far more extensive treatment of the educational system of many countries would have been very desirable, but lacunae in the work may be left to be filled in at a later period when some degree of advance has been made in this State toward a better system than exists at present.

A feature to which attention may be specially directed is the detailed character of many programmes of instruction. This elaborate development has been deliberate, for the somewhat common method of merely referring to the subjects taught gives no adequate idea of the instruction, and is in fact almost meaningless.

If, for example, a reference be made to appropriate chapters, it will be seen that some of the subjects of instruction have been most carefully developed. The organisation of the subject-matter or curriculum of instruction is often quite ideal, and the range and thoroughness remarkable. This much, for instance, may be said of the work in the Agronomical Institute of France.

It ought finally to be added, that, in these preliminary observations, there has not been time for a comprehensive and thorough revision of the various chapters in this report. This, however, is not so serious a matter as might appear, because although mistakes and crudities in the presentation of the various subjects dealt with may exist, and there may be errors in technical terms, etc., competent readers will have no difficulty in recognising what was intended.

As heretofore, each Commissioner presents his own conclusions; that course being considered to have eminent advantages over any attempt at a fusion of ideas, which might in many instances fail to express those of either Commissioner.

At the same time the elements of difference will be found to be less striking than those of agreement.

I.

I.

GENERAL.

[G. H. KNIBBS.]

1. *The Place of Technical Forms of Education in an Educational System.*—In dealing with the subject of Technical Education, the question of its proper place in the general educational system of a country ought to be clearly grasped. A little reflection will disclose the fact that its origins are to be found very early in the school career; in fact the little exercises of the kindergarten are its beginnings; and in elementary schools with a Sloyd, or indeed any organised system of manual training, technical instruction has already been fairly well advanced.

So also in the course of elementary instruction; every illustration or suggestion which exhibits the application of the sciences or of knowledge to the practical affairs of life, every lesson in writing or drawing which in any way indicates the utility of such subjects, is essentially a form of technical education.

Arithmetic, algebra, history, geography, etc., are treated in the elementary or primary school as instruments of mental training and culture; nevertheless, from time to time they are disclosed in their practical aspects, and when this is so, the instruction becomes to that degree, and in the wider sense, truly technical.

When these facts are borne in mind, it becomes evident that, in a very real and important sense, technical education belongs to every age of the school career. It penetrates and suffuses the entire system of general education. Like the second picture in a dissolving view, its outlines strengthen as those of the former picture disappear. At no point of time is general education free from technical elements; and conversely no good scheme of technical education is free from elements that may be entered under the category of general culture.

When this intimacy of relation between ordinary elementary and technical education is apperceived, the necessity of laying the foundation of the latter in even the earliest part of the school career will be fully admitted. Not only so, but it will also be felt that there is no hard and fast line of demarcation between general and technical education; the one shades off insensibly into the other.

This is but one consequence of the apperception of relation. It will also be apparent that the term "technical" properly includes much that it does not connote in ordinary parlance. Thus, though popularly it is otherwise, there are but few educationists who would hesitate, for example, to class "commercial education" under the heading "technical." And in the wider sense of the word it is evident that commercial, agricultural, and professional education are all properly classified thereunder. It is well to remind ourselves that etymologically the word "technical" (τεχνικός) supports this dictum. For ἡ τέχνη not only meant an art, a handicraft or a trade, but also skill, the means through which anything was achieved or through which an end was attained. Similarly we may recall the fact that τεύχω meant not only to construct in wood or metal, to build, forge, weave, but also to create or form, or shape, and it even carried the meaning implied in the word "well-wrought," or when applied to the mind, the sense of cultured and vigorous.

Technical education may consequently be regarded as that element which aims at directly preparing for the practical arts of every-day life. In a normal system of education, therefore, it is evident that it must permeate the whole scheme, and this, notwithstanding the fact that the stress of the effort in elementary and primary education should be to cultivate faculty in the most general sense; and notwithstanding also the fact that such education will deteriorate if the effort be exclusively focussed on the practical arts.

On the other hand, it by no means follows from this last dictum that the orientation of the teaching in the elementary school should wholly disregard the occupations which are later to be followed. For example in giving point to, and illustrating, lessons in science, the surroundings of the child ought to be taken into account. If the pupils' parents are agriculturists living in an agricultural district, and the lads themselves are to become farmers or farm labourers, that fact may well be

be allowed to govern the science teaching. In enforcing the scientific truths in the curriculum of the elementary school the whole scheme of illustration under the supposed circumstances would naturally relate itself to agricultural facts. In an industrial region, the same scientific truths might have to be differently exhibited, and their accentuation differently arranged.

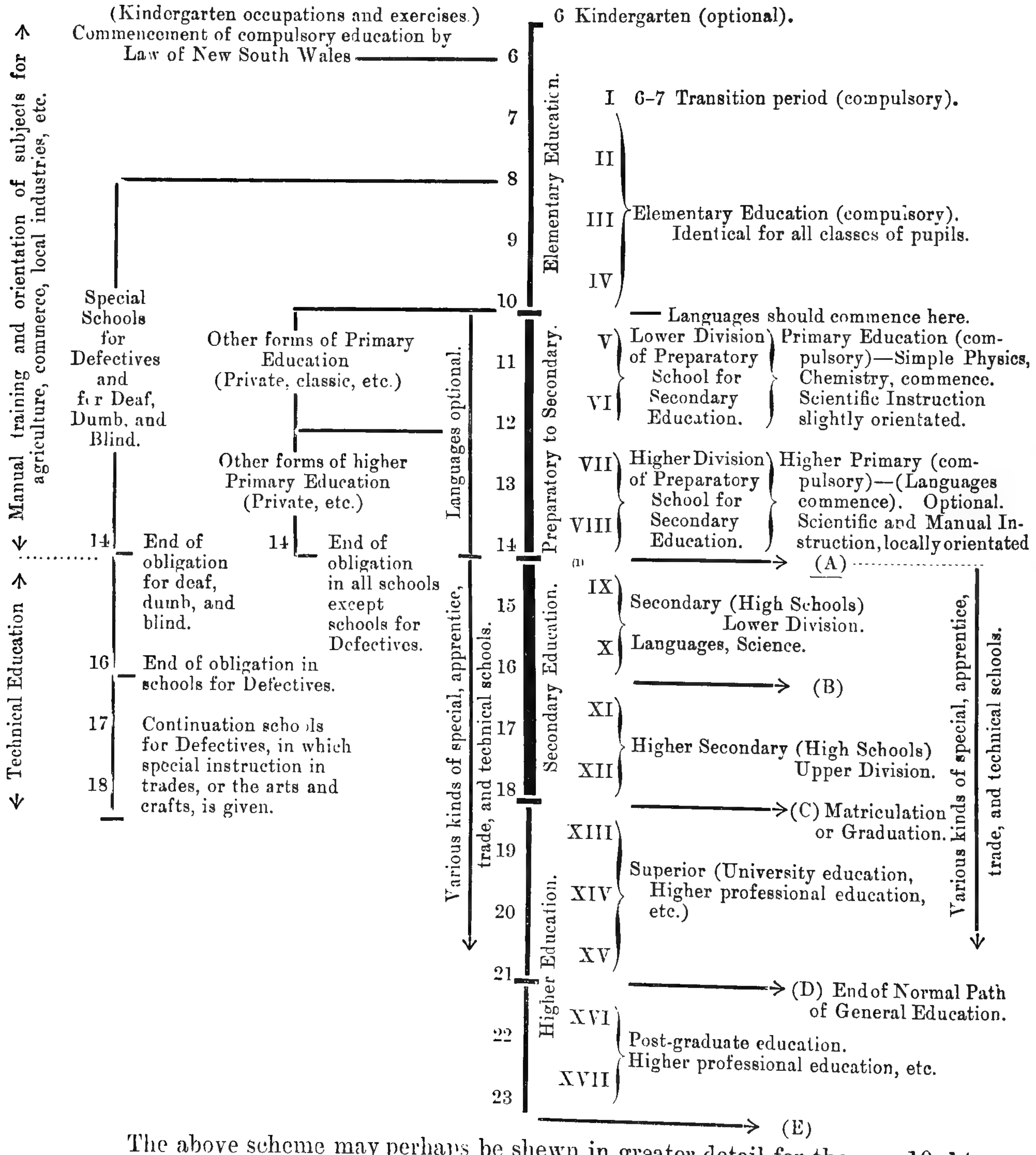
General considerations, such as the preceding, will reveal the necessity of treating technical education as intimately fused with ordinary education.

There is another point which also demands attention, that is the necessary variety of *grade* in technical education, to which we shall later refer.

2. *Co-ordination of Technical with General Education.*—In the diagrammatic outlines shewing a scheme of that type of co-ordination which any well-ordered educational system would disclose—in fact without which the use of the word "system" is meaningless—it will be seen that there is no arbitrary point at which technical education must be considered to commence.

A diagram illustrating this scheme of co-ordination is given because it will help us to keep in view the real nature of the problem of creating a system of technical education such as will meet all requirements, and yet form, with the general system a homogeneous or at least a harmonious whole.

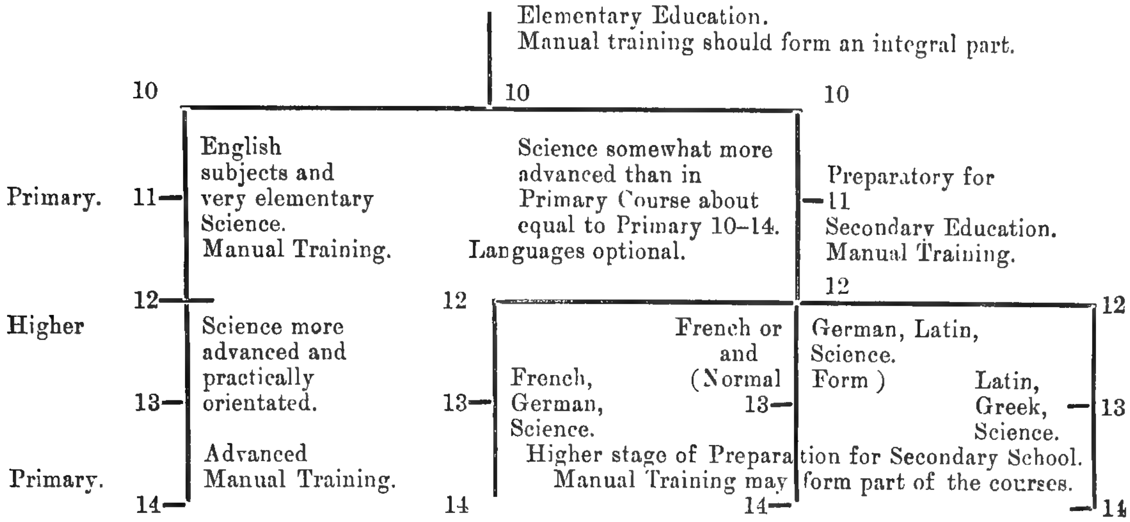
OUTLINE OF THE SCHEME OF CO-ORDINATION IN A COMPLETE EDUCATIONAL SYSTEM.



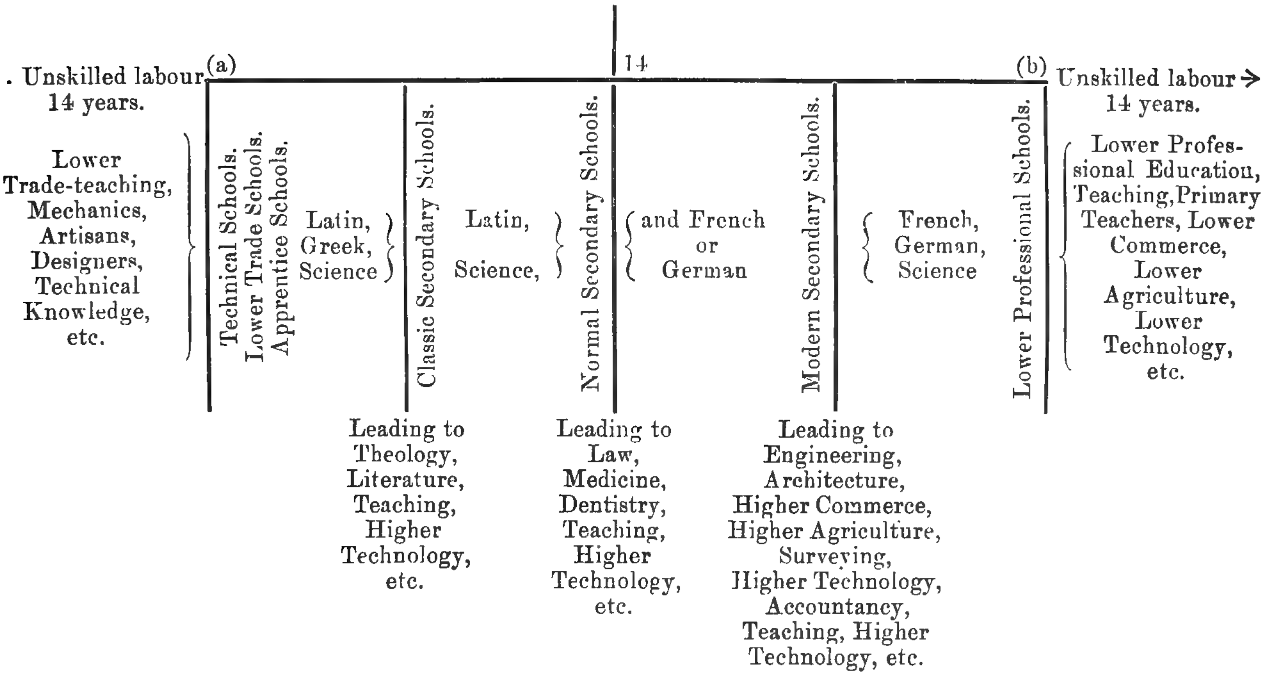
The above scheme may perhaps be shewn in greater detail for the ages 10–14.

TYPES

TYPES OF PRIMARY EDUCATION AND THE PREPARATORY STAGE OF DIFFERENT SECONDARY EDUCATION.



At the age of 14, lads who enter the ranks of unskilled labour may be supposed to abandon all systematic education. The other lines of educational qualification would then be as hereunder, viz.:—



The schools on the (a) and (b) lines may be night schools, but in some cases it is much better that they should be day schools.

With a definite scheme of *co-ordination*, such as is illustrated in the above diagrams, educational thoroughness becomes possible, for a complete educational organisation requires that a definite path should be followed, as was pointed out in an earlier report.

Such an organisation as above represented should be found in its entirety in Sydney, and the greater part of it in the larger centres of population.

3. *Distribution of Technical Elements of Education.*—It is well to bear in mind that the initial elements of technical education should be met with in the school career, before the technical courses proper are entered upon. This is essential if the educational system as a whole is to produce the best results. As previously indicated, such initial elements are to be found in the following schools, which are not technical in the special sense, viz.:—

Schools which are not technical in the special sense.	(1.) Kindergartens and Infant-schools. (2.) Elementary and Primary Schools. (3.) Higher Primary, Middle, and Secondary Schools. (4.) Schools for Higher Education, Universities, etc.

In the special sense of the term, technical education is to be found in schools of the following types, viz.:—

Schools in which special technical instruction is given.	(5.) Continuation, supplementary, "professional" schools (day or evening). (6.) Schools for instruction in the Arts and Crafts, in trades, in dairying, agriculture, etc., *i.e.* lower technical schools (day or evening). (7.) Secondary technical schools. (8.) Technical High Schools of various kinds, Universities, etc.

These will be referred to more fully in section 7 hereinafter. The point to be noted at the present moment is that, for the technical education of any country to be excellent, the initial stages must be developed in schools of the type (1) to (4). These stand in much the same relation to specialised technical education in schools (5) to (8), as the ordinary school career does to the practical affairs of life.

To adequately appreciate the advantages possessed under a good system, it will be necessary to carefully consider the effect of the inclusion of technical elements in schools of the type (1) to (4) above.

4. *The Technical Function of the Kindergarten.*—Remarking initially that these schools, to be efficient, must avoid all attempt to make technical education their main objective, that on the contrary they must aim at a general development of the pupil's powers and faculties, it is nevertheless true that the exercises and occupations of the infant-school and the kindergarten awaken and cultivate powers of observation, store the mind with information of a technical as well as of a general character, develope manual dexterity, give healthy direction to the activity of young life, train the little child in the power of self-expression, not only in thought and language, but also manually and in concrete things.

The kindergarten is, *par excellence*, the preparation for the primary school, just as truly as regards the technical or pseudo-technical features, as it is as regards the elements of general culture. Thus the child who has been through a good kindergarten is peculiarly well-fitted to enter upon simple forms of manual training in the primary school. He is a more accurate and altogether a better observer than he would have been without such training; and he has not only the prepared mind, but also the prepared hands; his fingers are no longer "thumbs," they have become skilled.

5. *The Function of Manual Training in Elementary Schools.*—Manual training in general has been discussed in the Report on Primary Education [Chap. XVIII, pp. 167–173, J. W. Turner; and Chap. XIX, pp. 174–180, G. H. Knibbs]. It is there pointed out that touch with the subject-matter of instruction ought to be *realistic*, not merely *literary*. Pestalozzi and Froebel saw by intuition that manual dexterity and practical intelligence might deteriorate in merely academic study, and hence they required that this fact should be taken into account in the scheme of education. Seeing, thinking, acting, are the foundations of educational development, and manual training proposes to give direction to the last—that is to acting as well as to call it into existence. In much of school education there is nothing to do but to *listen*, whereas in manual instruction the child is called upon to *do*.

Bearing in mind that manual training does not consist of a mere set of exercises in more or less difficult carpentry or ironwork, etc., but is essentially a series of exercises designed to be manually educative [*see* Primary Report, Chap. XIX, secs.

secs. 7 and 8, pp. 177–8], it is easy to recognise not only that it naturally follows the kindergarten, but also that it rounds off and completes the instinct of self-expression cultivated therein. Thus it is an ideal preparation for the school for special technical instruction.

This will more clearly appear if it be remembered that educative manual training aims at stimulating practical thought and affording exercise in concentration, that it tends to create unselfish ambitions and the love of work for work's sake, that it exercises the sense of form and evokes an appreciation of the beautiful, that it tends to implant a scorn of slovenly work, that it assists physical development, that it educates the faculty of comparing, inventing, and investigating, that it teaches how to measure, and assists in the formation of judgment, discrimination, taste, etc.

The value of manual training both generally and technically will further appear from the fact that it gives point to theoretical work. Arithmetic, algebra, geometry, drawing, and natural science are all co-ordinated in a proper system of manual training. Moreover, in towns it may be so arranged, as was pointed out by M. Léon Genoud in 1896, as to develope the æsthetic feeling of the future workman, and in the country it can be made to intensify the taste for agriculture, etc.

A child who has passed through a kindergarten, and then through an elementary and primary school with manual training (or Sloyd), has a conspicuous advantage over one who has not done so, when he enters the technical school, and for this reason the educational system of our State should ultimately conform to the indicated requirement.

The preparatory function of kindergarten and manual training suggests the general question of the necessary initial qualification for any grade of technical education. This will now be considered.

6. *Initial Qualification for entry upon various forms of Technical Education.*—A little careful consideration of the diagrammatic representation in section 2 hereinbefore, of possible educational paths, will render evident the fact that a branching off on to definite lines of technical education in the stricter sense may take place at any age which the obligations under the school system will allow.

It has been frequently remarked that technical excellence depends, not merely upon the quality of the technical schools themselves, but upon the thoroughness of the elementary or preparatory education; upon the soundness of the qualification for entrance thereinto.

The significance of this may be accentuated by an illustration. Some instruction in physics is a necessary part of certain technical courses; for example, those of engineering. Even elementary physics demands some slight mathematical preparation; for example, very elementary algebra. A pupil who proposes to take a systematic course in physics must therefore arrive at a certain stage of mathematical preparation. Unfortunately in our own Technical Colleges we have not insisted on this, and it is a common thing for a lecturer to attempt to instruct pupils in physics who do not understand the transposing of quantities from one side to the other of an algebraic equation.

The way in which this limits the efficiency of the instruction is obvious, and it explains how it comes to pass that technical education so often appears to be unproductive of the results which might have been expected of it. It shews too how easily it may come to be reprobated or held in derision.

In any system of technical education therefore that is not a fraud or pretence, certain demands must be made as to preparation for entry upon the technical courses. The extent of these demands will obviously be governed by what may be called the status of the course. An illustration or two will give clearness to this statement.

A carpenter and joiner, or a stonemason, will need to learn something of geometry, if he is to intelligently carry out his work. He will be the better for a little elementary knowledge of physics, because that subject also touches his work. The carpenter ought to know something of the laws of growth of a tree, the technical qualities of wood, the various processes for seasoning, making it hard or resistant, and so on. Hence he would require to attend lectures in botany, specially orientated with regard to his calling. [Reference may be made to Chap. XII, sec. 27, herein.] Similarly the intelligent stonemason will require to know something of geology and petrology, etc. Hence all preliminary studies which are necessary by way of preparation for attendance at lectures in these subjects, must be mastered as a condition of entrance.

Let

Let us revert to the question of the knowledge of physics necessary for either the carpenter or stonemason. Obviously it is less than is required by the steam-engineer, who perforce must know something of thermodynamics, at least if he is to understand the engines which he handles.

Or yet again, the carpenter need know very little of the *statics of construction*, though undoubtedly he would be an abler and more intelligent workman if he had a sound knowledge of it. The builder, however, who is entirely ignorant of the subject will certainly either waste material or run into danger, and is a pure empiric. In this way we see that while the carpenter may be excused from acquiring a knowledge of this subject, the builder cannot be, unless it is asserted that pure empiricism is sufficient.

Considerations of this character shew how important it is to have a scheme of initial qualification, which shall be graduated according to what may be called the academic status of the subject. [Chap. VIII is instructive in regard to this matter.] Wherever technical education is thorough, a sufficient preparation is always insisted upon.

We may divide schools for technical instruction, so far as initial preparation is concerned, into (a) those that assume only a primary education, as the necessary qualification; (b) those that assume some stage of secondary education; (c) those that demand a complete secondary education—this would include those that are domiciled in Universities; and finally (d) those that are of a post-graduate character, that is technical specialism of the highest grade. This division, and the above considerations reveal the importance of a general co-ordination of all branches of education, to the end that the development of its technical features may be satisfactory.

7. *The range of inquiry into Technical Education.*—The preparation for every calling or career, whether it be that of the *workman*, *artisan*, or even that of the *littérateur* or *artist*, is in part really technical. So also is the preparation of the professional careers, for the army, the church, the navy, for architecture, engineering, medicine, or surveying, for agricultural engineering, for navigation, shipbuilding, etc., etc. The term, however, is not thus broad in its connotation to "the man in the street," and it is necessary to delimit it. Unfortunately no definite delimitation is possible. *Industrial Art*, for example, is usually regarded as properly included within the scope of technical education, while possibly there are persons who dissent from the view that the Art of the Painter or Sculptor is essentially technical. Art in the latter sense, the "*Freikunst*" of Germany, the "*Vrijkunst*" of the Netherlands, or "*Fria konsterna*" of Scandinavia, is clearly dependent upon technique, which can be systematically imparted. On the other hand, industrial art and the industrial applications of art have no limit to their dignity, or to the possibilities of genius expressing itself in their development.

Here it may be remarked that the Commissioners, greatly limited as to time, had necessarily to restrict themselves as regards the range of inquiry. The question of pure and applied art teaching, for example, while by no means neglected, was not studied with the same thoroughness as agricultural, commercial, and industrial teaching.

The attitude adopted by the Commissioner may be explained as follows:—

Great attention was given to the question of kindergarten and manual training, as constituting the foundation on which the more advanced forms could be satisfactorily built. The technical work possible in elementary schools outside this range is obviously very limited. For boys, the manual training can with advantage embrace both wood and metal work; for girls, needlework, domestic economy, cooking, laundry work, etc. In both cases only the foundation should be laid, otherwise the general education will be impaired.

Next to the work to be done in the elementary school comes that which must be done in evening continuation schools. These are a feature in every educational system throughout the world, and were accordingly carefully studied. [It may be mentioned that in most countries where religious instruction is very systematically given in the day schools, Sunday morning classes for technical instruction are also a feature.] The continuation school proposes to do several things; for example, to advance the general education, and to afford instruction more directly adapted to the practical needs. It is therefore a type of school the advantages of which may well be wide-spread throughout the State.

The

The terms used by way of defining this type are, however, very various. For example, in Germany and some Swiss Cantons they are known as *Fortbildungsschulen*—*i.e.*, schools continuing education; as *Ergänzungsschulen* or schools for completing the education—supplementary schools; as *Uebungsschulen*, or practice schools; as *Wiederholungskurse*, or courses by way of repetition of the school work, with however an advance thereof; or as *Repetirschulen*, repetition schools—and in French Swiss Cantons as *écoles de répétition*. In Italian speaking regions they are known as *corsi di ripetizione*—repetition or recapitulation courses. The supplementary character of the work they do is expressed in the French phrase *les écoles complémentaires*. Such schools are sometimes called simply evening schools (*e.g.*, *Abendschulen*, *cours de soir*, etc.).

It is remarkable how deeply interested the pupils often are in their work; and how ardent in the desire to advance by embracing the opportunity of improvement. This appears to be characteristic throughout Europe.

The work of the continuation school so far as it relates to technology is mainly theoretical, or consists largely of drawing, or similar courses, the character of the work being determined by the need of the case.

Next to the Continuation School the Commissioners gave considerable attention to the Trade or Industry—*i.e.*, artisan—schools (*Gewerbeschulen*, *Industrieschulen* in German; *Ambachtscholen*, in Dutch). These are sometimes called practice schools—*écoles de pratique*—of various kinds, *écoles d'industrie*, *écoles professionnelles*, *écoles industrielles*, etc. In such schools there is always practical work to be done, and the instruction usually divides into two branches, viz.:—(*a*) technical—*i.e.*, theoretical—and (*b*) practical (*enseignement technique et enseignement pratique* in the French schools). Such schools are most important, and had necessarily to be carefully examined.

The most complete form of this type of school is the Apprenticeship School (*école manuelle d'apprentissage*). In this the form of the practical instruction is akin to that under trade conditions, and the pupils are really apprentices. But the system is vastly superior to that of ordinary apprenticeship; in fact there is no fitting comparison between the two. Special attention was consequently given to this type of school.

Besides these there are two other types of school in Europe which demanded earnest study, viz., the ordinary and the higher technical school. In Austria and Germany the former is known as the "*Technikum*," the latter as the Technical High School ("*Technische Hochschule*.") The latter is a technical University. The difference between the two may be recognised by the demand made in the way of entrance qualifications. In the former the pupil is permitted to enter at an earlier and less mature stage of the educational career; in the latter the same qualification is insisted upon as for entrance into the University. Thus for entrance into the German *Technische Hochschule*, the students must have passed the *Abiturienten Examen* of the *Oberrealschule*, the *Realgymnasium*, or the *Gymnasium*. Incidentally it may here be mentioned that students who have passed through the latter only (*i.e.* the classical secondary school, in which they learn Latin with sufficient thoroughness to use it as a vehicle of conversation, and Greek almost as thoroughly) are required to give special attention to science subjects in the Technical High School.

The nearest approach to the instruction which is given in the Technical High School of Europe is to be found in the Universities of the United Kingdom, or in such institutions as the Royal College of Science, or the more advanced courses of the Polytechnics. But the result is not quite comparable, for the preliminary training of the student of the Technical High School is much better.

It is now evident that so far as school-career is concerned, technical education is to be found throughout—*i.e.*, from the kindergarten to the University, both inclusive, but in the special sense it is to be regarded as dating from the time at which any special type of instruction, qualifying for practice in an art or calling, commences. Strictly speaking a continuation school is merely one which continues the elementary education to a more advanced stage, giving it at the same time a more technical form; it may also include new instruction of a definitely technical character.

For the ordinary workman or craftsman, the type of education developed in the continuation school may find a suitable completion in apprenticeship, or in an apprentice-school, and this completion may be contemporaneous with the work of the continuation school.

In

In this connection it may be pointed out that the apprentice-school is often so organised that a portion of the day is devoted to the theoretical part of the subject, and the remainder to practical work in the workshop.

The range of technical education may be considered from another point of view, viz., that of adaptation to the demands of various classes occupied with the same subject-matter. Thus engineering ranges between the work of the lathe-hand, the fitter and turner, and that of the civil, or mechanical engineer.

8. *Grades of Technical Instruction.*—It might appear that any country which had possessed a thorough system of technical education for a considerable time, and, perhaps, especially one which was densely populated, could dispense with schools for technical instruction of short duration. But the modern development of such instruction has been rapid, and hence one finds that most countries have organised short technical courses to aid those whose general opportunity for acquiring what they need has been insufficient. These courses may be of a somewhat general character or they may be special.

Thus it has been found necessary to provide—and these may be found in towns and cities in very many parts of the world—courses of instruction in the mother-tongue, in modern languages, in arithmetic, geometry, physics, chemistry, drawing (freehand, trades, technical, etc.), in modelling, singing, gymnastics, as well as in book-keeping, technology, manual training, and even such subjects as machine-sewing, tailoring, ironing, millinery, etc., etc.

Some of these are taught in relation to particular occupations. For example, upholsterers have a special course of freehand, perspective, compass, and ornamental drawing, and, finally, professional drawing immediately connected with their work. In Berlin, for example, there are courses in technical drawing for carpenters, joiners, cabinet-makers, turners, ornamental woodworkers, braziers, ironworkers, locksmiths, gold and silver smiths, engravers, electroplaters, masons, mechanicians, mechanics, clock and watch makers, painters and decorators, upholsterers and furnishing decorators, etc. The value of such instruction is beyond dispute.

Special instruction may consist of a short series of lectures, with or without practical demonstrations, or it may consist mainly of demonstrational work. For example, in Belgium short courses in dairying have done a great deal to increase the production of butter and other dairy products, and to improve the quality thereof. Again, much advance has been made in agriculture through short courses of lectures on modern advances in the subject.

Other examples of short courses of instruction are those provided for apprentices in various trades. The larger establishments which are characteristic of modern industry have made the old form of apprenticeship a thing of the past. When the master of an establishment had only a small business, and therefore but few hands, it was possible to give the apprentice a considerable amount of personal attention, so that, despite the fact that the whole scheme of instruction depended more upon the exigencies of the business than upon the demand for educational thoroughness, the apprentice in a long course of years did obtain a fairly thorough knowledge of his craft, and the craft was, in general, advanced by those who possessed natural genius, rather than as a result of the educational value of the apprenticeship scheme of training.

As this condition passed away, and was replaced by the modern industrial régime, it became more and more necessary to provide schools which should supplement and assist the instruction of the workshop. These dealt with the principles of the sciences, or of the general knowledge underlying the various crafts, or with drawing, etc., in relation thereto. In some cases courses of short duration were found valuable to the apprentices, or were the only courses likely to be attended. Such courses mark the lower reach of modern technical instruction not embraced in the work of the elementary school.

The most advanced grade of technical instruction is, of course, that found in the University or Technical High School. Evidence has been rapidly accumulating that scientific knowledge is of great and often of inestimable value in the economical and satisfactory development of industrial processes. Even the very fate of an industry in a particular country may be determined by the extent to which scientific knowledge is availed of. An excellent example is the rapid improvement in beet-sugar production from 5·72 to 13·00 per cent. by the combination of botanical,

agricultural,

agricultural, physical, and chemical researches. Other notable examples are the development of the aniline dye industries, the improvement in the iron industries, the industrial applications of electro-chemistry, the manufacture of paper and silk from wood-fibre, etc., the products of the electric furnace, the conversion of water-power into electric energy, and so on.

The highest forms of scientific training, and the cultivation of the genius of applying scientific knowledge industrially, are not only valuable, they are sometimes the determining factor in the history of an industry.

The wealth that has been developed in the industries that have been created by the advances made in organic chemistry constitutes one of the most striking instances of the conspicuous part that science plays in the industrial processes of to-day. Physics and chemistry have become of increasing importance to the engineer. All this goes to shew that the purview of technical education must embrace the needs of the highest occupations as well as those of the humblest, hence the technical schools will range from those which demand, as a necessary preparation, only a primary education, up to those which demand the very highest scientific education that a true University[1] can provide.

The various grades of technical instruction consequently comprise the following :—

(1.) Preparatory courses, embracing extensions of ordinary school subjects with a practical orientation, or embracing the natural sciences, often specially considered in relation to their technological applications.
(2.) Courses of theoretical instruction directly relating to technical matters, such as trade and technical drawing, or the principles of any handicraft or trade or occupation.
(3.) Practical and workshop courses covering only particular and restricted fields.
(4.) Definitely organised courses in the arts and crafts, embracing all the requirements for the education of the highest type of workmen, with or without a complete scheme of workshop practice.
(5.) Secondary technical schools for the education of those whose calling is of higher grade than the artisan, and of lower grade than the professional callings.
(6.) High Schools and Universities for the education of those who desire to embrace professional careers.
(7.) Post-graduate courses of work for the education of the highest type of specialist in various branches of technology.

In developing a system of technical education, the whole range of wants of the community as it stands at the given moment must be considered. Hence the courses should be designed to assist persons to attain to higher industrial perfection, notwithstanding that such courses are not ideal in a finally developed scheme. In every country the development of the technical instruction exhibits this feature, and in this State it will be found necessary even to engender the disposition to take advantage of such forms of instruction as can be offered.

Initially, considerable difficulty will be found in getting suitable instructors. That is a question to which we may now turn.

9. *Technical Teaching and Instructors.*—The pædagogic principles governing technical teaching are essentially the same as those applying to other forms of instruction. It is required in educative manual training and Sloyd that the instruction must be *systematic*, and must be given by a special teacher, who is an educationist, and not merely by an artisan or good workman. In the early stages of technical education in various countries, it was found very difficult and often impossible to get properly qualified instructors. But it was early recognised that no system of technical education can possibly be satisfactory that does not apply the principle cited.

The second important principle is that the instructor must be highly qualified in his own proper sphere: he must be more highly qualified than the pupil he is to take in hand in the subject-matter of the instruction. For example, an

[1] That is one which aims not merely at producing erudite students, but students who add to the world's wealth knowledge.

an instructor in "fitting and turning" ought to be something more than a good "fitter and turner." Besides being an expert workman, he should be theoretically well-informed in his own sphere of work, and in everything relating thereto. He should have some knowledge of educational principles; should understand the far-reaching aims of educational systems, viz., those which touch the question of character, the building up of national efficiency, the creation of a class of workmen who will be enthusiastic as to the quality of their own handiwork.

In the highest forms of technical education it is similarly important that the instructor should not only equip his students with technical information and familiarise them with technical procedure, he should be competent also to create in them the professional spirit, the capacity to advance their art or calling, to apply their knowledge to those new problems which are ever presenting themselves for practical solution.

The general aim of good technical teaching is to rationalise it throughout its range; to replace mere imitation of procedure by an intelligent study thereof; to substitute for the blind following of its subject-matter, or of workshop practice, an effort to grasp the principles of both, so as to be independent of mere routine. The "how" of any process is not sufficient; the student must know the "why."

The instructor, consequently, must himself be a student of the reason why technical processes, or workshop or laboratory practice, follows a certain definite course; he should understand whether this is important or may be varied at pleasure; and so on.

The effect of training under such an instructor is generically different from that produced by a mere empirical workman. It developes an intelligence and alertness which, in these days of swift change, is often of very great value. Workmen trained by competent technical instructors are not only far better qualified for their own immediate trades or callings, they are more apt in adjusting themselves to changing industrial conditions.

After what has been stated above it would seem hardly necessary to say that instruction should be realistic and practical. But in this State we have often allowed mere memory and book work to be substituted for real knowledge. Talks about science and about technical processes are different from an experimental knowledge of science and a practical acquaintance with technical procedure. The latter are essential for real progress. Lectures, for example, on engineering practice are inadequate unless followed up by actual work in the engineering workshop; and, similarly, lectures in chemistry ought to be followed up by practice in the chemical laboratory, if a real knowledge of chemistry is desired. All theoretical knowledge needs to be correlated with its corresponding practical application.

For this reason the material equipment of establishments for technical education is very important.

10. *The Equipment of Technical Schools.*—In order that a scheme of technical instruction shall give the best results, the material equipment must be complete. While students should be taught to attain their ends with a minimum of apparatus, they should also be instructed as to the use of the most complete apparatus for the purpose in view, and the exact nature of the advantages which it confers. The laboratories and workshops of the modern technical schools seen by the Commissioners were as a rule magnificently developed, and that is true of nearly every country, but perhaps particularly of Germany. Lavish additions were being made to a great many equipments at the time of the Commissioners' visit; in fact, there was on foot a decidedly progressive movement which has continued ever since.

11. *The Commissioners' Task.*—The general matters referred to will give some idea of the scope of a study of technical education and will give some idea of the Commissioners' task abroad. That is but part of the task, however. Unfortunately, our local standard of comparison is so behindhand that a mere report that disparity existed would fail to give a real picture of the excellence of education in so many other lands.

Experience has shewn the Commissioner that the accuracy of the view here expressed is frequently challenged, particularly by persons who have seen nothing of the remarkable educational development in Europe of recent years. Such persons may be reminded that Professor K. Pearson, F.R.S., in his Huxley lecture "On the

Inheritance

Inheritance of Mental and Moral Characters in Man and its comparison with the Inheritance of Physical Characters," said, as lately as October, 1903, that:—"Our traders declare that we are no match for the Germans and Americans. Our men of science . . . proclaim the glory of foreign universities and *the crying need for technical instruction.*" He boldly affirmed that it appears there is "a want of intelligence in the British merchant, in the British professional man, and in the British workman."[1] *This is from our own countryman*, after a prolonged and brilliant study of the whole question, and after contributions to the analytic discussion of statistics that constitute almost a new era therein. We shall do well to swallow any pride that operates only to hinder us in learning the truth. Not only so, but it is well to recollect that the accumulating testimony to this effect is engaging the serious attention of public men and educationists in Britain.

To create an adequate idea of the character of the various branches of education in other lands is by no means an easy task under any circumstances; the difficulty is increased in proportion as disparity exists between other methods and our own. Experience has shewn this most clearly. Even in concrete and physical matters this proposition is true. For example, it may be mentioned that although the marked inferiority of our school buildings, especially judged from an educational point of view, was fully explained in the Commissioners' Interim Report, the public criticism of that report by many educationists *in this* State shew to how slight an extent the essence of the matter had been generally grasped. Our buildings are as seriously defective as any buildings *of their class* can possibly be; yet that fact makes relatively no impression.[2]

The criticism of secondary education has also proved that, while individuals recognise that there is considerable disparity between it and European secondary education, the seriousness of such disparity is almost wholly unappreciated. The same difficulty will probably manifest itself in regard to technical education.

With a view to helping those who desire to understand the truth of the matter, the Commissioners have given in the chapters hereinafter a fairly extensive account of the features of the technical forms of education in other lands. The programmes furnished will enable us to recognise where we stand, and in this connection attention may be drawn to the programmes of the Institut Agronomique of France (Chap. XLIV), to the organisation of the Zürich Polytechnicum (Chap. XXXIII), and to the scheme of the Technical Universities of Germany (Chaps. XXXI and XXXII), all of which will illustrate the point made.

The *thoroughness* which is found in the elementary or primary schools of Europe is found in schools of all grades. The spirit that promotes this is uniquely that which we need, and the Commissioners' task is to attempt to make this fact manifest.

---

1 Journ. Anthropological Institute of Great Britain and Ireland. Vol. XXXIII, 1903, pp. 179–237; see p. 206.
2 A school is being built upon new lines, however. This may be the forerunner of a better class of buildings.

II.

IMPORTANCE OF TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Introduction.*—To understand the defects of our system of technical education, it ought to be borne in mind that the strong indictment of our systems of primary and secondary[1] education, made in the two previous reports of the Commissioners, has as yet made but little public impression. So far the steps taken are not commensurate with our needs, *if we intend to approach in excellence the educational work of Europe* or of most of the States of America. In the Summary of the Report on Primary Education [II, 2, p. 8] it was stated that the seriousness of the defects of our system could hardly be overstated. When it is remembered that our vote for primary education is such that we do not spend per pupil in our *sparsely populated* State as much as is spent in, say, the densely populated areas of Hamburg or Bremen, notwithstanding that education in a sparse population must necessarily be expensive, the status of our educational ideals will be recognised. When then it is further remembered that *for our technical education the vote is only the one twenty-eighth part* ($\frac{1}{28}$) *of that for primary education,* it will be seen that we practically *ignore* the need for that form of education. Its importance has certainly never been adequately perceived, for if it had, public response must have followed. The development of our technical system has thus far been under the ægis of the Department of Primary Education (Public Instruction), which, as was pointed out in the Report on Primary Education, had failed to give our educational system that place in the world's educational effort which its more progressive teachers and officers have long hoped for, and which our national welfare demands. It has been pointed out that nothing short of a radical reformation, touching every plane of our primary system, can effect the great change necessary to constitute it "a peer among the nobler systems of civilised mankind" [Interim Report, X, 4, p. 61], and that unless we intend "to accept educational inferiority as our permanent characteristic," we must not regard progress, elsewhere achieved, as impracticable for us. [Report on Secondary Education, II, 8, p. 6.]

So small a vote as the present, viz., about £30,000 per annum for technical education, for a State the size of New South Wales, and for a population of about $1\frac{1}{3}$ millions, discloses only too well our public indifference to one of the most important factors in our national life. It was pointed out in the Summary last mentioned that we dare not accept the situation as it stands, and that not to face our educational problem with earnestness would be nothing short of national insanity. [*Ibid.* II, 16, p. 8.]

It might seem a work of supererogation to have aught to say on the *importance* of any branch of education. But the truth is that *we have been lulled to sleep by self-satisfaction.* Many have believed that our system was "the best in the world." To deny it this merit was an act of disloyalty worthy of condign punishment, and the view that to ascertain and declare the truth is the only loyal thing to the State and to its subjects has not had the prominence that one might have hoped.[2] This state of things has perhaps passed away, but it is by no means unimportant to see that it is not re-established. Briefly,

[1] In fairness to the English Schoolmaster, it ought to be stated that his indictment of the prevailing system is often severe. Thus, Mr. Lyttelton, headmaster of Haileybury, and the headmaster-elect of Eton, admits the infirmity due to absence of training. [*See* "Nineteenth Century," June, 1905]. An "Old Etonian" writing in the *Morning Post* of 2nd June, 1905, discussing Mr. Lyttelton's paper, states openly that "Eton is out of date, 'and turns out' a stream of miserably taught and cynical boys," cynical because they must feel that much of their study was "but a fruitless waste of time."

[2] In other countries educational criticism is outspoken and fearless, and often extremely severe. Sensitiveness about en criticism is a most unhealthy sign, and unfortunately is present in this State.

Briefly, it may be said that the necessity of advance in technical education has not yet been adequately felt, and the existing system is subject to the same severe indictment as was primary and secondary education. For this reason a few remarks on its importance will not be out of place.

Chapters I and II herein, referring to general matters, and to the various forms of technical, industrial, and professional education; chapter III on the question of the relationship of apprenticeship to education; and chapter IV on the urgency of better technical education in the United Kingdom, disclose this importance, not only as regards the mother country, but also this State. This is apparent if we bear in mind that the system of technical education here is subject to greater limitations than those which recent effort in the United Kingdom is endeavouring to correct.

To fulfil its function a technical system of instruction must embrace the needs of all classes, not only those of the ordinary artisan, but those of his instructor; not only those of the workman himself, but also of those who are to direct his labours. Indeed it is of high importance that industrial operations should be well directed technically. The principle referred to in the Reports on Primary and Secondary Education, viz., that in general the instructors must be better educated than their pupils, also applies.

Efficiency in the lower planes of industrial effort is contingent upon efficiency in every grade, from the highest downward. And it is important that all effort should be influenced by the highest and most advanced.

2. *Our National Status in Technical Education.*—To understand our status as regards technical education, it is necessary to remember that in New South Wales it is but a weak reflection of that of the United Kingdom, carrying with it not only all the infirmity of the technical system of the mother country, but the added limitation of domination by persons whose practical experience was limited to our imperfect system of primary education.[1] The exact nature of this will be more fully referred to hereinafter.

Some conception of the state of technical education in the United Kingdom may be had from a glance at the effort of the London County Council during the years 1893–1904. Reference should be made to Chap. XXXIX, sec. 4, for fuller information. The total annual expenditure on technical education during the period referred to was as follows:—

Progressive Expenditure on Technical Education by London County Council.

	£		£		£
1893–4 ...	4,529	1897–8 ...	117,744	1901–2 ...	173,104
1894–5 ...	41,999	1898–9 ...	128,999	1902–3 ...	236,505
1895–6 ...	76,560	1899–1900	145,358	1903–4 ...	305,213
1896–7 ...	115,533	1900–1 ...	207,747	1904–5 ...	...

Notwithstanding this progressive and rapidly-increasing expenditure, those who have compared the state of technology in the United Kingdom with that in Europe are alarmed at the disparity. [See Chap. IV, sec. 2.] Lord Rosebery, Dr. Haldane, and others, refer to our national attitude as regards this matter in most disquieting terms, and the Special Committee of the London County Council, consisting of very able men of the widest experience, presented a Report on 15th July, 1902, which demands the grave attention of every well-wisher of the British Empire. From the continental point of view the total amount devoted to technical education is regarded as "ridiculous" in its smallness.

After pointing out that the defects of general (*i.e.*, primary) and secondary education, together with the defects of higher scientific education, are responsible for the unsatisfactory condition of many British industries, and after explaining the injurious influence of examining authorities (Universities, etc.) upon the stimulation of the reflective powers of students, the report goes on to shew how definite is the connection between educational system and satisfactory industrial development. It quotes with approval the remarks of Mr. J. W. Swan, F.R.S., who stated that America, France, and Germany were rapidly developing their equipments for technical

[1] It perhaps ought to be said that there are very many officers in the Department of Primary Education who have longed to see an advance made: who have fretted under the regime which fettered and victimised them and their pupils. Those who knew better were officially without freedom, and could not effectively voice their opinions, and for the existing state of technical education the immediate heads of the Technical Department were by no means responsible.

technical education, and "*hence the wonderful growth of industry abroad.*" And after referring to the fact that "England is doing comparatively little in the way of education," while America is doing a great deal, he says :—

"EDUCATION AND SUCCESS IN INDUSTRY CANNOT BE DISASSOCIATED. WE MUST REPAIR THE NEGLIGENCE OF THE PAST, OR WE MUST SUBMIT TO NATIONAL DECAY." [See Chap. IV, sec. 2.] As to the competency of the witnesses there can be no reasonable doubt.

The decision to spend a larger amount on technical education in the future testifies to a recognition of the serious deficiency from which we are suffering.

Without going into detail it may be mentioned that such a country as Japan is giving a degree of attention to the development of technical instruction, which we should do well to emulate [see Chap. XV, secs. 14, 15], and is making an effort, in comparison with which our effort is extremely meagre.

There is another way in which our national status in technical matters may be estimated, and that is by the curricula defining the courses of instruction. For this reason the Commissioner has translated some of these *in extenso*, as was done in the case of secondary education for the same reason. The courses in agronomy in the Agronomical Institute of France [see Chaps. XLIV, XLV] may be cited as an example of an excellent series of programmes of work.

Touching the status of the instruction it is said that "we are giving to the "classes at the bottom of the industrial ladder a disjointed smattering of miscel- "laneous science of no great value, though probably good so far as it goes, while we "are neglecting to *thoroughly* educate those upon whose shoulders will soon rest the "weight of the management of our great manufacturing industries. We are now "practically 'copying' the methods and models of America and Germany, etc."

Another member of the committee sums up our British status in technical education in the dictum that "At University College, London, for instance, the present provision is not equal to that in a third-rate German or American technical college."

Professor Dewar stated that our school system is incompatible with the times, and that unless it is radically changed "we cannot expect to fight the German successfully in the industrial competition." Another deponent testified "that England has not taken the opportunity of (technically) training men, so "as to be capable of developing such industries," and also that abroad (*i.e.*, out of England) knowledge is the test for any advancement. [Chap. IV, sec. 4.]

The report of the special committee to the London County Council is ominous in its reiteration of the low status of the English system of technical education, and indeed of the other elements of English education. Yet this is the system we have weakly copied—the poor ideal to which we have not even yet attained.

Lest it be thought that this British evidence may have been exaggerated, it may be well to point out that the fact is recognised in America. Thus in the "Twelfth Census of the United States" [vol. X, p. 527], it is mentioned that the German chemical manufacturer is far in advance of those of *all other nations* in recognising the value of specialised chemical skill, and so on. The same remark applies to other industries.

To state the whole matter in more general terms, we are undoubtedly behindhand in recognising the industrial value of the higher form of scientific and technological training. And this means that we must suffer serious loss as regards national wealth. What is true of the mother country is true to some extent here also. Our problem is certainly a different one from that of the United Kingdom, but we need none the less to advance in the thoroughness of our technical system of education.

3. *National Loss through Technical Inefficiency.*—As implied in the preceding section, the fact is impressing itself upon public men in Great Britain that considerable loss has been experienced through absence of a good educational system. The London County Council Committee states definitely that various industries have been lost to Britain, through foreign competition, rendered more effective through the "superior scientific education provided in foreign countries." [See Chap. IV, sec. 3.] An illustration is given taken from statistics of dye production. Madder and cochineal have been replaced by alizarin and azo-scarlet; synthetic indigo is not only equal to the best grade of the natural product, but is physically in

a

a more convenient form, and is rapidly displacing it. Cane-sugar cannot compete with beet-sugar owing to an improvement in the culture and manufacture of the latter (increasing the yield from 5·72 to 13 per cent.) dependent upon the extension of scientific knowledge and its application to the industry. The committee point out that Jena optical and other glass has been taking the place of English, on account of its superior quality; that the Bureau of Education of Prussia and the Legislature have enabled experiments to be carried out on a manufacturing scale by "very liberal and repeated subsidies," that in the United States, Germany, and Switzerland, rapid development has taken place in the manufacture of electrical machinery; that the material needed was obtained from foreign countries, that in ceramics "foreigners are in advance." The committee further points out that "the loss of "any industry . . . has far-reaching effects; it prevents the birth of cognate "industries . . . it discourages research; . . . it induces buyers forced to "go abroad for what they need to purchase other goods which may be equally well "obtained at home."

Other examples are given accentuating what is above stated. [Chap. IV, sec. 3.]

4. *The Function of Technical Education Explains its Importance.*—Technical education is by no means wholly utilitarian; when properly organised it is in a high degree *educative*. Originating, in a normal educational system, in the Kindergarten, and passing on to a more advanced stage in the elementary school, it finds its fullest development in the schools that prepare more immediately for the serious work of life; the schools that directly equip us for our callings. These schools, at least in Europe and America, do not merely aim at making a man dexterous as a craftsman, and capable of work creditable to him, but at making him an intelligent workman with some outlook, and competent to idealise his industrial effort.

An example was indicated in the Commissioners' preliminary report on Technical Education. [IV, sec. 7, p. 18.] It was pointed out that the Hungarian student in wood-working learns something of the morphology and growth of trees, the reciprocal relations of the roots, trunk, branches, and leaves, the theory of proper times for felling, the methods of seasoning timber, the chemical composition and technical qualities of woods, the impregnation of timbers to preserve them by means of zinc chloride, tar, etc., the use of pneumatic apparatus, the actions of acids and alkalies, the use of colouring matters, varnishes, etc.; of oily and alcoholic lacquers, waxes, polishes, etc., etc. So also do the pupils of the technical schools of other nations.

It is obvious that a course of lectures and demonstrations on such matters by thoroughly competent experts, immensely increases the interest of the daily work of a tradesman, to say nothing of the possibility it confers of attaining to good workmanship and some speciality of treatment. [Chap. XII, sec. 27, pp. 139–140.]

Another example which might be mentioned is the renowned school for typographers in Paris, the Ecole Estienne. The instruction includes among other things the history of writing, of the execution and decoration of manuscript works, of the printing, illustration, and decoration of books, the development of photo-chromo-lithography, the history of external decoration. [Chap. IX, sec. 14, pp. 83–4.] Or yet again, the instruction in decorative composition in the same school may be taken as an example; it is full of general interest and is most highly educative. [*Idem* sec. 19, p. 87.]

These illustrations give an idea of the type of outlook on their special work which the continental systems of technical instruction confer upon the students.

A more adequate view will be possible if it be further remembered that no artisan is *narrowly* educated for his special craft. A fitter and turner may learn merely to use a lathe, etc.; he is then merely an empirical workman; or he may learn something of the nature of the metals and alloys, of the history of the machine-tools with which he works; he may learn the kinematics of the machines he has to use, and a number of other similar things. He may learn something of the remarkable physical properties of metals, etc. In the latter case the man becomes a rational workman, alert to all matters touching his occupation, and it has been found that such a workman is not only more deeply interested in his daily work, he is more truly an *artist* in his work, he is better able to adapt himself to the exigencies of modern industry, with its liability to change by the introduction of new machinery, through improvement of methods, and so on. When

When the higher forms of technical education are placed under review it is seen that the same considerations apply no less cogently. The higher technical school in continental Europe is really a university; it is rapidly becoming one in the United Kingdom. In some of the more modern English universities some forms of technical education have already received unqualified domicile, while even the most conservative have been compelled to modify their attitude by the pressure of circumstance and the compulsion of public opinion. And while the distinction maintained in continental Europe between the technical high school and the university is undeniably the best for any country of dense population—and given a good system of secondary education, the tendency will be to differentiate higher technical from purely scientific, philosophical, or linguistic studies—there can be no doubt that the effort to advance technology, rightly understood, may well take a dignified place among the higher efforts of mankind.

The endeavour to make the so-called utilitarian needs of man adequately reflect his ideals of civilisation; the effort to make his handicrafts capable of results which shall worthily express his sense of the beauty of form and colour; the striving to exploit the wealth of nature's resources, not merely so that our material needs shall be multiplied into profusion, but that they shall attain to greater magnificence and excellence, are aims well worthy of recognition in the schools of highest effort.

The tendency toward mutual depreciation which a few years ago was somewhat marked as between the technical high school and the university in continental Europe is disappearing as each developes, and the reactions of the effort of higher technology upon the university and of university effort upon the technical school are both favourable.

That remarkable prejudice, which professional men of limited outlook sometimes betray, causing them to overestimate the dignity of their own calling, and underestimate the merit of others, tends to disappear with the advance of the higher forms of education. The ignorant artist, for example, may hold the exponent of industrial art in contempt, fancying that his own art is alone *liberal*; but the well-informed artist is fully aware that the industrial applications of art may take the highest rank, and that the art treasures of the world exemplify this.

No one can consider the relative facility with which, at moderate expense, our homes may be furnished with articles of beauty, as regards both form and colour, without perceiving the immense value to mankind of modern technology. Compared with what was possible during any previous period of the world's history of which we have any knowledge, we have enormous advantages; and this is due to the inventive genius displayed in the creation of machinery, to the genius of scientific discovery, and to the genius of applying both to human wants, those wants taking on higher forms—expressing the progress of human culture—at every step.

5. *Value of Technical Education to a new Country.*—The preceding considerations accentuate what may be called the idealistic function of technical education. The purely utilitarian side may be also considered briefly. A knowledge, even of the most elementary character, of technical matters advances our power to achieve practical ends. Thus if every boy and girl had passed through an *educative* system, or even a mere *trade* system of manual training, we should have been in a position of greater advantage than we are at the present time.

Moreover, if the pupils of our elementary schools had gone through even the most elementary course of science and nature study, that is, were taught to look out upon the material universe with more intelligent eyes, their ability to perceive their opportunity would have been greater than it is.

American farmers were taught much by school-boy demonstrations as to what seed-selection could do, and Europe and America recognise now that seed-testing stations are of great economic importance to agriculture.

In this State, the immense value of such work as is being carried out, for example, by Mr. Farrer, in cultivating varieties of wheat to satisfy special demands—*e.g.* rust-resisting—is an example of the economic value of technical knowledge and of scientific research.

Belgium is a country which has large areas of agricultural land. The modern developments of agricultural science have disclosed the fact that scientific knowledge is a factor in productiveness of undreamt of importance, and probably every farmer there now recognises that fact. No one who is cognisant of the contributions of modern

modern technology to improvement in dairying and in agriculture will hesitate to admit that our country will advance more rapidly when technical knowledge is more widely spread and is more thorough.

Very often technical knowledge makes all the difference between assured success and miserable failure. And in exploiting a new country this is just as true as in older ones. Improvements in agricultural knowledge, in the technique of farm-management and dairying, in the growth of wool, in breeding stock, in metallurgy, in forestry, must all mean advance of our material wealth.

Technical knowledge, for example, makes excellence in production possible, and in this way assures a market once captured. That has been illustrated by the improvement brought about in butter production in Denmark; the quality is both high and uniform, conditions which command success, and which have meant a certainty for the Danish exports of this commodity.

6. *Practical Recognition of the Importance of Technical Education.*—All that has been said above may be academically admitted, and yet such admission be worthless; in fact, worse than worthless. We have, roughly, a quarter of million children attending school, between the ages of 6 and 14. If the period for technical education be regarded as roughly one third of the duration of that for primary, about 80,000 would have to be provided for. For this the State gives only £30,000 per annum, per pupil, say 7s. 6d. each per annum! This is the appropriation for the purpose of teaching the girls' cookery, domestic economy, and the arts and crafts open to them, and for giving the lads in our State that instruction in trades and industries, in commerce, in elementary agriculture, and so on,[1] which they require!

Now a *real* recognition, as distinguished from a merely academic one, of the importance of technical education, would appear in a perception of the fact that the expenditure of a much larger sum would be economically sound. No one who gives the subject the least consideration, will fail to see that if we devoted, say, *five*, or even *ten* times the amount, say 40s. or 80s. per annum, per pupil, the increased wealth-producing power would be much greater than the educational outlay.

No country spending so small a sum as £30,000 per annum, on its Department of Technical Education, with a school population of over 250,000 children, can be regarded as having seriously applied itself to the problem of providing such education, and the importance therefore of that branch of education has, so far, not been *practically* recognised by the State, however readily a tacit admission may have been made that it is of real value.

What is really required is, that definite recognition of the economic value of a sound system of technical education, which shall induce us to provide it. The half-hearted, badly-organised system which exists at present cannot yield results worthy to be compared with the better methods of the other hemisphere.

Other countries have grown in power, and their industries have been developed through technical education. The United States, Germany, Switzerland, etc., were enabled to supply England with electrical and scientific apparatus, with dyes, chemicals, etc., because of the excellence of their work in this direction. [*See* Chap. IV., sec. 3, pp. 17-19.] Germany's industrial development, her expenditure on technical education, and her percentage of students taking up higher education, exhibit a collateral progression.

In Europe technical schools have been founded in *anticipation* of requirements, and have practically been the means of creating industries. Here, the method is *to wait for a demand* for some special form of instruction, and then to provide it imperfectly. What is sorely needed is the spirit which enables the requirements of industrial development to be foreseen, and which demands that they shall be met. This is the type of practical recognition of the importance of technical education which is found in Europe, and which explains the remarkable developments of industrial energy there.

No intelligent observer, free from prejudice, can travel in Europe and fail to recognise that we are here in an unsatisfactory condition educationally. In support of this statement, the remarks of a member of the teaching staff of the Sydney University, who was educated here and in America, and who has recently returned from an educational visit to Europe—not the first—may be cited. The gentleman referred

[1] I omit the consideration of the secondary schools of agriculture under the Department of Mines and Agriculture. But the addition of the appropriation will not materially affect the argument.

referred to, Mr. S. H. Barraclough [B.E., Sydney; M.M.E., Cornell], in his presidential address to the Engineering Section of the Royal Society, pointed out that since all progress is relative, the essential question is whether its rate here is equal to that of other countries or not. He stated that his recent trip to Europe forced upon him the conclusion that in the matter of engineering, technical progress, and industrial training *we are distinctly falling back*. He says—"One is impressed with the fact that there is extraordinary activity in other countries; that in noting the signs of progress in German institutions during the last two or three years one cannot help . . . . realising the impossibility . . . . of keeping our institutions abreast of theirs." England, as he says, herself in no enviable position, is leaving us behind; while in America progress is so rapid that it is almost impossible to keep oneself thoroughly posted as to its details, colossal sums being continually invested in scientific and industrial training.

After referring to the fact that America's vast opportunities and immense natural resources have specially contributed to her success, he argues that we have more than ordinary cause to bestir ourselves.

Then, adverting to the marvellous growth of Germany, he reminded his hearers that a Royal Commission from England pointed out, only about a decade after the Franco-Prussian war, that "England had everything to fear and many things to learn from her new rival. The situation becomes annually more acute, and to-day England is realising the risk she runs of losing—possibly for ever—her position as the leading manufacturing and commercial nation of Europe."

Mr. Barraclough quotes Professor J. B. Johnson as saying:—[1] "That an interior country like Germany, without a navy, and with little foreign commerce, could in a quarter of a century increase her manufacturing capacity tenfold and make it equal to that of England; increase her shipping twenty-fold, making it second to that of England; effectually establish a regular export trade with every country on the globe, and by at once cheapening products and improving their quality, put herself in a position to hold these markets indefinitely; that all this could be accomplished in the face of open competition, and in this age of universal publicity, is indeed marvellous, and would alone prove that old methods have lost their potency and that something new has arisen under the sun."

That "something new" is educational organisation, and Germany and Japan are illustrious examples of its significance. Frederick William III of Prussia was right when he believed that the crushing defeat by Napoleon in 1806 could be retrieved through education.

Japanese achievements afford even a more striking lesson than German as to what is possible of attainment through an educational system, and Mr. Barraclough in his address recognised this, pointing out that the recent history of Japan is a striking "illustration of deliberate adaptation of means to an end, of national organisation on a large scale, and with *unparalleled efficiency*," and also of the *ne plus ultra* of patriotism and loyalty. He further remarks that the presence of an enemy at our gates would quickly reduce matters to that basis of reality which at present is wanting, that, especially in a democracy, "national success can be achieved only through the responsible and deliberate efforts of citizens," and that "national efficiency, the adaptation of means to ends, is what is lacking at present in the British nation." And he incisively affirms that, on the whole, we in this State, are subject to the same criticism.

The address referred to discusses the comparative advantages that would have accrued to England if £100,000,000 had been spent in ten years in technical and industrial education rather than £250,000,000 in three years in war.

One is again reminded of the criticism of Dr. Peters that *England's expenditure on industrial and technical education*—compared with Germany—*is ridiculously small*. One cannot resist the conclusion that nothing short of a system of primary education equal to that of European countries as a foundation, with a superstructure of technical education equally thorough, will meet the needs of our State, and that it is only from the standpoint of national destiny that the gravity of the existing situation can be rightly appraised.

[1] Proc. Soc. for the Promotion of Engineering Education. Vol. VI.

III.

III.

APPRENTICESHIP IN RELATIONSHIP TO TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—Apprenticeship to-day is so dissimilar from what it was in the days of the trades guilds that such merit as it originally possessed as a means of education in craftsmanship can no longer be unequivocally credited to it. At its best it was a very imperfect method of instruction, for educative efficiency had often to be sacrificed to the exigencies of a master's business. And hence it comes about that modern methods of technical education tend more and more to eliminate apprenticeship; and where it is not eliminated modern conditions involve a fundamental change in its general character.

The importance, from the standpoint of public education, of a careful consideration of the question of the most desirable relation between apprenticeship and technical instruction must be apparent to any one. [Chap. I, sec. 7; pp. 2–3.] It is here briefly referred to, and is later discussed at some length. [Chap. III, sec. 1–13; pp. 7–14.]

The bitterness of disaster, and the humiliation of failure in industrial and commercial rivalries, have taught some nations the unqualified necessity of improving their systems of technical training. This way of acquiring experience is, however, expensive. In some instances there was no general recognition of inferiority until the issues of war disclosed it, a fact that it will be well to bear in mind.

2. *Absence of General Recognition of Defective Nature of Apprenticeship.*—Locally it has been often stated that the better class of tradesmen are becoming more and more scarce. The younger men engaged in trades are said not to be equal to their elders. This fact has given rise to an opinion that apprenticeship should be insisted on, the proposed object of this insistency being to ensure efficiency.

That the matter has engaged serious attention is obvious from the views expressed by persons specially qualified to judge as to the efficiency of the workman of the State.

In the Eighth Convention of the Master Builders Association of Australasia, held 7th June, 1904, the President, Mr. A. Midson, in an able address, said:—

> Much is said on the subject of technical education by people who are not qualified to speak with authority. Attention is often directed to Germany and other Continental States as examples, and we are told that technical training is the best safeguard against foreign competition. I have no desire to underrate the value of technical instruction; but I consider a thoroughly practical training, such as the apprentice system (now falling into disuse), added to common sense and a liking for mechanics, is the better training for our young tradesmen.

It is rather surprising to find "technical instruction" and "practical training" referred to as if they were antagonistic terms.

Mr. Thomas Loveridge, in his important and valuable address on the same day, after pointing out that the question had arisen whether it was not necessary to make a radical change in the system of elementary education, says:—

> I had not intended to touch upon this phase of the question but for the fact that for some years past an effort has been made to combine the teaching of trades with the hitherto ordinary school subjects. I do not for one moment pretend to say that it is out of place to introduce the system of practical work or manual labour as part of the school curriculum; but I venture the opinion that at best the training thus

acquired

acquired is but an adjunct to the more solid and practical knowledge gained in the workshop or on the building, and does not supply that disciplinary training which must be first and foremost in the production of an efficient workman, whether he works with his head or his hands.

So far as the technical education is concerned, there can be no doubt that, within reasonable bounds, it is a primary necessity; but to outrun discretion, and to allow the public mind to suppose that nothing is needed beyond the training which a lad receives at the Technical College, Sydney, the Working-men's College, Melbourne (or some such State academy), to make him an efficient workman, is in my opinion calculated to lead to most disastrous results. Not only is the public misled by this notion, but the lad himself becomes imbued with the idea that the journeyman of many years' experience, beside whom he works, is no more capable than he is of performing certain work. Taking my own city, for example, plumbing licenses are granted only to lads who have finished the course laid down by the regulations, and obtained the certificate of competency from the Technical College. Whether these lads have had actual training of real work and workshop experience does not enter into the matter—the fact that they have passed through the College is taken as sufficient guarantee of their ability to be entrusted with the most intricate class of work that may happen in actual practice. Time after time lads of this character have been found lamentably wanting as compared with workmen who had received a thorough grounding from trained journeymen in the practical work on the building or elsewhere as distinguished from those trained under college teachers.

This experimental system of making artisans (!) is not confined to one trade, but in a more or less degree it obtains in all the other trades, and the knowledge thus obtained with regard to these trades is to a very large extent of a superficial character. As a stonemason myself, I can conceive instances where all the theoretical knowledge possible to be obtained at the College would not be sufficient to enable the student to carry out certain work, and other members of this conference who are skilled in different trades will, I venture to say, be able to multiply such examples. *The great evil of technical education, as departmentally administered, lies in the fact that the general public is allowed to believe that the system meets all the wants and necessities of the case,*[1] and that a lad need only be sent to one of these emporiums of learning to be turned out a thoroughly skilled and efficient mechanic. This is a serious error, and reacts not only upon the building interests of the Commonwealth, but also on the sons of fathers who are thus misled.

My enquiries point to the fact that the system of apprenticeship in New South Wales is unsatisfactory,[1] and I may quote the railway workshops, where it is the custom for lads to be taken into the shops as required, to learn fitting, turning, etc. They are not bound apprentices, but are able to resign, and are liable to dismissal in the same way as the journeymen. They are also subject to the same rules and regulations. They are not taken in under the age of 15 years, and are not out of their apprenticeship until the age of 21 years, so that going in at 15 years they receive for the *first two years* 5s. per week, 7s. 6d. per week for the next year, 12s. per week for the next year, 18s. per week for the next year, and 30s. per week for the last year, and they have then completed a six years' term. At the end of the term they are paid wages proportionate to the value of their services, if there are vacancies available, and their general conduct has been satisfactory, and they are eligible in all other respects. These regulations are stringent, and though the lad has served the full period under what might be considered efficient supervision, still the regulations go to prove that *the mere fact of having served the full term is not a guarantee of the production of a competent mechanic.*[1] If this be so when working under every-day conditions at the trade, does it not seem absurd to suppose that the training given at an academic training college can properly equip the lad with all necessary skill? I contend that the mere statement of the Railway Commissioners that after serving six years still a lad might not be deemed desirable for employment as an artisan, effectually disposes of the opinion held by some persons that the fulfilment of a stated term at a college will bring forth a fully trained workman. The conditions prevailing at one of our large engineering workshops is practically the same as those at the railway workshops. One of the most convincing proofs of the superiority of the indenture system is afforded in a reply given to me by one of the largest firms in New South Wales. They forward me a scale of premiums and periods of apprenticeship, and at the same time they say, "This year we have not taken on any of these apprentices, as the prospects of trade were not at all satisfactory."

Such views as are expressed above are representative of a really widespread public opinion. They are the views of able men of considerable experience. But the conclusions reached are undoubtedly not the only ones possible, and, moreover, they could not have been arrived at in any country possessing a really excellent system of technical education. They are conclusions which, if just, point simply to the very great limitations of the existing scheme of technical education in our State. They do not prove more than this, viz., that under existing conditions apprenticeship is still a necessary part of a complete scheme of technical training; in other words, the technical colleges of the State, as at present organised, have by no means dispensed with its necessity. It is imperative, therefore, that those who wish to make our system of technical instruction accord with the national welfare, should face the question whether apprenticeship cannot be advantageously replaced by a scheme of systematic instruction. And this question should be faced with a sincere regard for the fact that the national destiny is profoundly affected by the answer given.

3. *Advantages of Systematic Instruction as compared with Apprenticeship.*—In the days of the trades guilds the industrial operations carried out under a single individual were ordinarily so limited in extent that it was then possible for him to supervise and instruct the apprentices engaged in his particular branch of trade. Modern

industrial

[1] The italics are not in the original.

industrial conditions have changed all this. Apprentices under the circumstances existing to-day cannot be efficient without great loss of time, if at all. At no time in the history of apprenticeship was it an ideal system. The educational efficiency of the scheme of instruction had always to be more or less subordinated to the business interests of the master. The most superficial consideration makes this obvious. If a master had to consider nothing except the question of making his pupil technically competent *in the shortest possible time*, he could attain his end in a relatively short period. His own services, those of his workmen, and of his pupils, had, however, to be so ordered as to secure him the maximum financial advantage personally. To this end he had to sacrifice the proper interests of his pupil to a greater or less extent.

As the industrial conditions have changed, the pupil has been subjected to continually increasing disadvantages, which had to be counterbalanced by such instruction in day or evening schools as was necessary to make the combination of workshop and theoretical instruction tolerably complete.

Evidently the co-ordination of the two elements, the theoretical-scientific and the practical, is essentially imperfect under this system. The tasks of the pupil in the workshop cannot be so organised as to constitute them the natural complement of the theoretical and scientific instruction. Even the proper progression of the practical exercises must often be hampered or thwarted by the limitations imposed by the exigencies of business.

In systematic instruction, on the other hand, the theoretical and practical elements of the instruction are made mutually helpful by properly co-ordinating them. Each not only mutually assists the other, but the stage of each is carefully adjusted so as to make the mutual assistance a maximum. The instruction, moreover, is specially arranged so to make its educational value as high as possible; and further, the outlook upon one's industrial energies is made wider, self-culture is better developed, and a more intelligent view of one's work is obtained.

4. *Early Recognition of Advantages of Systematic Instruction.*—The great limitations of learning any art by apprenticeship are so conspicuous that it is not astonishing that they were early recognised. In France, for example, in 18C8, during the liberal ministry of Duruy, it was perceived that, *in the interests of national efficiency*, technical education by apprenticeship must give way to a scheme of thorough systematic instruction. The disasters of the war of 1870 accentuated this view, and in 1872 M. Gérard proposed the opening of a school for instruction in wood and iron industries. He demonstrated the national necessity of replacing the method of learning through apprenticeship by that of learning from that systematic instruction which could be imparted only in a properly developed school. He shewed that the then existing means for preparing young people, on leaving the primary school, for their life callings were insufficient; that in the apprenticeship system, egoism operated in various ways strongly against the national interest; that the master of apprentices was compelled to sacrifice the welfare of his apprentice more or less to the exigencies of his business; that workmen, reacting to a narrow egoism, and often incapable of perceiving the issue from the standpoint of national development, were hostile to apprentices, and were by no means friendly to their entry into the ranks of workmen; in fact, that the old system of apprenticeship was subject to many defects, and, as a method of professional education, was intermittent, without order, and opposed to the interests of the people considered as a whole. [Chap. IX, sec. 2, p. 79.]

The view thus stated will carry conviction to anyone who will give the subject careful consideration. Should it fail to do so in the abstract, a comparison of the work done by the students of systematic technical schools of the type indicated with that done by apprentices will not so fail. The difference is very striking, and is unequivocally in favour of the systematic instruction.

Some account of the French schools which turn out accomplished workmen is given in Chap. IX hereinafter. As observed in sec. 14 of that chapter, p. 83, "It is worthy of remark that persons who go through such a school have advantages which nothing we have to offer in Australian technical education approaches. And although it may be impracticable to make technical forms of education here equally thorough until the whole plane of our educational method is raised, the ideals need to be created so as to give us an aim-point for progress."

One

One need only review the programmes of instruction outlined in the chapter referred to, in order to perceive how much higher is the apprentice-school than the type of school in vogue here. The truth is that our type of technical instruction cannot be compared for excellence with that which is being rapidly developed and extended in Europe.

5. *Industrial Work seen by the Commissioners.*—The excellence of the results obtained in the continental schools for systematic instruction in the Arts and Crafts is undoubtedly very striking. For example, the so-called Artisan Schools of Russia for the technical education of young lads turn out work which can be described in no other way than as excellent. The work seen by the Commissioners in the lower degree artisan school of St. Petersburg eclipses anything turned out in our technical colleges: yet it is done by young lads only. And no doubt is left in the mind that the apprentice-school is vastly superior to apprenticeship as a method of technical education when the results under the two systems are compared.

Attention is drawn to the work of the Apprentice-School of Berne, Switzerland, by way of further confirmation of what is above affirmed. The creation of this school was expressly stated to be due to a recognition by the Swiss authorities of the superiority of German workmen as compared with the Swiss: this type of school was to be the corrective. The courses are of three years' duration for all branches, and the entrance age 15. [Chap. XI, secs. 8–11, pp. 110–117.] The skill attained by the pupils is all that could be desired.

It may well be asked, "How many of our young people of 18 years of age can turn out wood and metal work equal in general workmanship and artistic merit to that illustrated on pp. 114–115 hereinafter?" The photographs, of course, fail to give an adequate idea of the fine finish of the work, but they give a good general idea.

The perfection of this work is not confined to France, Russia, and Switzerland. That seen in Germany and Italy was similarly excellent, and one is reminded of a remark of Gariboldo's, viz., that the cardinal problem for the fortune of Italy is essentially an educational problem. [Chap. XV, sec. 11, p. 167.] The cardinal problem for New South Wales is the same: if we are to be the industrial peers of other countries, we shall have to greatly advance our system of technical education, and radically improve its methods.

6. *The Lesson of the Tuskegee Institute in Alabama.*—The remarkable work of Mr. Booker T. Washington in Alabama, in industrially educating negroes, confirms the opinion that the Apprentice-School is one of the most efficient types. The majority of the courses are of three years duration, the lads entering at the age of from 14 to 16. At the Tuskegee Institute the conditions of working are practically identical with those occurring in the ordinary work of the trades represented. The results are so good that a whole chapter has been devoted to a description of the Institute's work [Chap. XX, secs. 1–46, pp. 223–235], and the programmes have been outlined at some length with a view to indicating the real excellence of this very fine educational movement. The initial requirement is an elementary education, and the object of the courses is to so correlate the literary and industrial training that the student shall be compelled to get both. The rapidity of progress and the excellent character of the trade-work done in the short period demanded (three years) stand in very fine contrast with the results attained by long apprenticeships (very often seven years).

7. *Higher Forms of Apprenticeship.*—By way of illustrating fully the forms which apprenticeship takes to-day, Chapter III hereinafter gives an account of the Baldwin and the Brown and Sharpe Apprenticeship systems of the United States, and the apprenticeship system of the British Royal Dockyards. It makes some references also to apprenticeship in America, in the United Kingdom, and to similar features of practical instruction in various other countries.

In the Baldwin Locomotive Works system the apprentices are graded, the initial position being determined by previous education. Advancement depends upon personal record, and at the end of the apprenticeship period, the position assigned is such as the record warrants. [Chap. III, secs. 4–8, pp. 8–12.]

It

It may be noted that this question of apprenticeship has of late received a very considerable amount of attention in England. Quite recently Mr. D. Drummond, the head of the Locomotive Department of the London and S. W. Railway, in an article on "Technical Education for Apprentices"[1] points out that the system of passing on from school through college to workshop is a very bad one. The "sandwich system" of alternating six months of theoretical instruction with six months, workshop practice is, according to the same authority, only fair, and, the system of say three years' collateral theoretical and practical instruction in *day* classes, is undoubtedly the best. Mr. Drummond deprecates evening classes as dangerous on account of the strain they impose on the health of boys working all day.

This testimony of an able man of large experience confirms the opinion that systematic instruction is the only scheme that can lay claim to thoroughness and high efficiency.

The opinion of Mr. E. S. Parks, of the Brown and Sharpe Manufacturing Company, is that the "technical schools," though they have produced excellent results in many ways, have failed to produce exactly the class of workmen needed, and that a return must be made to the old apprenticeship system as nearly as can be done in a large factory. [Sec. 4.]

Mr. Parks is, however, obviously speaking without knowledge of European apprentice schools, and does not seize the point of the whole matter as clearly as does Mr. Barter of the British Institute of Naval Architects. Mr. Barter points out that "in the private shipyard" or engineering works the apprentice is regarded by his employers *mainly* in the light of a *profit-producer*, and in return he is *permitted* to learn the business up to the point of making a workman of himself. In the Royal Dockyards the apprentice is regarded in the light of a *student*, and practically unlimited facilities are afforded him for the acquisition of the most useful forms of scholastic and technical education, although no premium is required.

8. *The Liberal Attitude of German Manufacturers.*—German engineering and manufacturing firms generally go a long way to facilitate that enlargement of the general outlook, and that practical touch with every-day conditions which are afforded in the well-equipped workshop and factory. Students of the technical high-schools or universities are taken, not only without premium, but at as high a rate of wage as 4s. per diem. This may be done before the lecture courses and general work in the technical school are completed. [*See* Chap. III, sec. 10, pp. 12–13.]

Germany has recognised, perhaps, as vividly as any other country, and more vividly than most, that the welfare of her citizens and her national power depend upon education. So marked is the interest of her manufacturing firms that some of them not only encourage all their hands down to the office boy to attend technical classes, they even provide libraries with technical journals. In some instances any employee has merely to request that particular technical journal be lent to him, it is then *brought*, and he has merely to guarantee its safe-keeping and return.

Let the attitude expressed by the adoption of such arrangements be compared with that expressed by the practice, still so common with us, of demanding a considerable apprentice premium for technical training, or of treating professional education received academically as if it were comparatively valueless.

In the United Kingdom there is a growing recognition of the value of preliminary technical education, and employers are even refusing premiums, "*preferring apprentices with brains to those with money only.*" [Sec. 8, p. 11.]

9. *Testimony as to the Defects of Apprenticeship.*—In 1900, the Technical Instruction Committee of Manchester issued a pamphlet on a scholarship scheme originated by a firm of electrical engineers. [S. Z. Ferranti, Limited.] Mr. Brocklehurst, the author of this pamphlet, points out that *technical schools do what even the modern apprenticeship system fails to do.* They enable men to discharge the far larger range of duties demanded in modern industrial activity. Mr. Barter, before referred to, indicates that the alleged decline of industrial supremacy of Great Britain has been attributed to the faulty methods practised in educating technical workers: he himself states that it would be more correct to say that it is due to "the absence

[1] Technics, Vol. III., No. 14, Feb. 1905, pp. 151–4.

absence of any method at all." After shewing the character of the limitations in apprenticeship to a business firm, he remarks that even in the case of what are known as "premium apprentices" the lads are left practically to their own resources and inclinations as regards educational study, which of course is not true of the fully organised technical school.

The best testimony, however, that the method of apprenticeship, even with all the advantages of well-organised scientific and technical instruction, has been felt to be quite inadequate, is to be found in the creation of trade and industry schools in Continental Europe and America. No one can see the so-called "apprentice-schools" for systematic technical instruction, and view the work actually turned out therein without recognising their immense superiority. [*See* Chapter III, sec. 12, p. 13.] A system of technical instruction such as we have in New South Wales cannot compete with that of countries which possess apprentice-schools. Schools for apprentices are undoubtedly helpful but are relatively inferior, and if our scheme of technical education is to materially advance it must follow the lead suggested.

10. *Economic Aspects of the Question.*—In viewing the relationship of apprenticeship and systematic technical training to the great question of developing an efficient scheme of technical education, individual interests must, as a question of State policy, be subordinated to the general good, which, after all, is ultimately best for the individual.

Any dispassionate observer will have noticed that even in professional walks of life there exists a more or less pronounced antagonism to any policy which appears likely to intensify competition by multiplying the numbers of those entering them. As the scientific and technical knowledge underlying professional callings advances, the demand that the would-be practitioner shall acquire a range of information such as was never possessed by many, or even by most of those already in the field, is not wholly unknown.

Again, so-called "practical men" in some of the professions whose professional success frequently depends, not upon their own knowledge, but upon their power to exploit the abilities of other men, are often the reverse of sympathetic with a healthy professional advance achieved through higher education. The insecurity of their own positions, the perpetual danger of an exposure of their technical or professional ignorance, which is sometimes masked under a claim of possessing organising or administrative ability, makes them hostile to that type of progress which is really necessary in the interest of the community. The reason is obvious. Just in proportion as the progress is sound, so does all such charlatanism run risk of exposure.

The great economic losses which are perpetually occurring through professional incompetency are by no means always patent; they often result without being perceived even by those responsible for them; and when they are more or less clearly perceived it is hardly to be expected that the culprit will be sympathetic with such advance of professional knowledge as is likely to expose him.

That these things are not fictitious, and that they have an unfavourable reaction upon education, no one who has given the matter systematic attention has the slightest doubt. But, in the shaping of the educational policy of a State, it is needless to say that such influences should as far as possible be eliminated. The shielding of incompetency, the securing of positions on other grounds than professional and general fitness, and the maintenance of nepotism and its analogues, are matters with which State policy, if concerned at all, is concerned by way of antagonism.

The hindrances which professional limitations, fears, antagonisms, and jealousies oppose to the adoption of the best forms of education, have an analogue in the attitude which is sometimes to be found among employers and among workmen toward the best form of technical instruction for their own classes. It has already been stated that in France a narrow egoism operated against the national interest. Workmen are often hostile to apprentices, and are by no means friendly to their entry into their ranks as workmen. The French authorities clearly recognised that the apprenticeship system was not only intermittent, and without order educationally, but led to situations strongly opposed to the interests of the people as a whole. [Chap. IX, sec. 2, p. 79.]

The fear of all classes, even of producers, and much more of those who are not directly producers, is that their ranks will be overfilled, and that to their detriment; and since the views of many persons are profoundly affected by personal considerations, it is necessary in reviewing educational questions to treat them from the standpoint of the Statesman, who considers solely the national aspects of the problem.

11. *National Destiny as affected by the Apprentice Question.*—The egoism of class-interests, which is more than ordinarily liable to obtrude itself into a consideration of the problem now under discussion, cannot be allowed to do so. We all tend to look upon our particular form of activity, or the quantity of work available for our own class, as a *fixed quantity*, which, if distributed among a limited number, enables each to obtain the maximum advantage of the situation. This tendency expresses itself overtly by inducing all to oppose everything that *seems* inimical to the individual advantage. Hence workmen, where they have not taken account of national destiny as one of the most important factors in the question, even for themselves, are apt to regard restrictions, placed in the way of those who desire to learn a trade, as advantageous. In its immediate effect it may be: in its *remote* effect it is certain to be disastrous, as a dispassionate review of the whole matter from a wider standpoint will reveal.

Remarking initially, that the solidarity of the community demands sacrifices on all sides, and that a policy of unrestricted egoism, consistently followed by each class, would mean national suicide, it will be obvious on reflection that an educational policy, which, with reasonable economy, equips the people in every needful direction in the *least possible time* for a given but *sufficient degree of industrial efficiency*, is the only one that can be accepted in a rationally governed State.

Reasonable economy clearly denotes also that an economy which takes *all* circumstances into consideration, and which does not hesitate to be liberal in the matter of educational outlay, if in the complete view liberal expenditure is indubitably indicated as necessary is the only *true* economy.

The reaching of a sufficient degree of efficiency in a minimum time is evidently of great importance when the fact of international rivalry is looked fairly in the face. The *economic stability* of any country, and especially of one which, through newness, has not established financial stability on the basis of vast accumulated wealth, as is the case with England, *depends upon its wealth-producing power*. This is measured by the *rate*, assuming it to be suitable, at which production can take place; and this again is governed by the rapidity with which a sufficient degree of productive efficiency can be attained by the units of its population.

The phrase "sufficient degree of industrial efficiency" has been used. In this connection it is well to remember that, whether we will or no, we live in a world of industrial and commercial rivalries, and that no political system whatever can secure us against such a condition of things. Even if the State or Commonwealth could be self-sustaining, and we were also a peer among any of the great countries of the world, an equal efficiency with them would be essential to maintain equality of relationship and of general status. When the question of exports is taken into account, it is immediately evident that so far as their quality and quantity can be made dependent on our technical efficiency, we cannot afford to be behind other nations.

Every country has its own problems to solve; its inhabitants have to discern where their opportunities lie; they must discover what forms of wealth it possesses and then exploit them; their schemes for the production of wealth must be at least as well-directed as those of other lands; and hence their policy of general and technical education must be as advanced as it is elsewhere.

If, by the action of any class of citizens, the industrial and commercial efficiency of the State as a whole should ever be impaired, a retrograde step will have been taken, which may be either absolute or relative to the progress of other countries, it matters little which.

However positive the *opinion* of some persons that apprenticeship, plus a certain amount of theoretical technical instruction, is the best scheme of technical education, there can be no doubt that the school of systematic industrial instruction, the so-called "*école manuelle d'apprentissage*" of France, and the similar schools of other lands, are the most efficient, and produce from every non-egoistic point of view, the

the best results. These schools may not enable a certain class of employers to exploit labour to the same advantage as the apprenticeship system, but they will be appreciated by every reasonable employer of labour. And when the question of national efficiency and national development are taken into consideration, such schools are unequivocally to be desired. If we really mean to have our people technically educated, we must not only give all apprentices adequate opportunity to improve their knowledge, we must do more, viz., develope schools for a complete course of instruction such as will turn out workmen thoroughly and systematically trained in a very much shorter period than is at present possible through apprenticeship.

12. *Foreign Criticism of our Industrial and Commercial Position.*—No competent critic has any doubt that, whatever tendency toward political divergence may arise between an autonomous colonial State and the mother-country, the integrity of both as against the world depends largely upon Empire unity. With the abstract political question this Report is not immediately concerned, but with the question of technical education in relation thereto it is. The testimony of Dr. Carl Peters, as expressed in "England and the English,"[1] is worthy of note. No one who has read the work and who has direct knowledge of the facts will doubt the fairness of the criticisms.[2] Dr. Peters says that "it is beyond question that *the shallowness of national education,* due in the first instance to Britain's school methods, *is driving her fast into an inferior rank for science and industry* to that occupied by other countries, more especially Germany and North America."[3] He points out that England's expenditure on technical education for 1901–2 was only £1,000,000, which, he says, is "*quite a ridiculous sum in comparison with the corresponding expenditure in Germany.*"[4] When the population ratio is taken into account, and particularly when the natural cost of education in a scattered population is considered, *our little vote* for technical education—viz., about $\frac{1}{33}$ of the above amount—*is equally ridiculous.*

Again, referring to commercial education, Dr. Peters says "*commercial schools proper do not exist at all,*" and he adds, "no wonder, then, that the English clerk is beaten in all parts of the world by the German."[4]

Our own kinsman, Professor Pearson, indicates, as we have already pointed out, that the testimony of competent Englishmen is to the same effect.

The great significance of the whole question is exhibited in the following passage, also from Dr. Peters' book:—

> The sovereignty of the oceans is, therefore, the vital question for the Anglo-Saxon race. Once deprived of the power of controlling the seas, Great Britain would immediately sink to the standard in the world's stage now occupied by Ireland. On the other hand, we see from the facts laid bare that *the fate of this Empire depends* also on the possibility of becoming a purely financial community with all the consequences of such a system, *i.e., on the question whether her industry is to follow in the wake of her decaying agriculture, or whether British statecraft and policy will be able to save the State from such unrestricted dependence on foreign production.* These two problems—the lasting predominance at sea and the maintenance of British industry against foreign competition—form the nucleus of all the work which English policy will have to deal with in the twentieth century. Everything else is subordinate. If Great Britain were to cease ruling the waves, she would not only at one stroke lose her political eminence amongst the nations of the earth, there would also be an end to English luxury and to the very livelihood of at least half her inhabitants. *If the industries of Manchester, Sheffield, and Birmingham were to follow in the footsteps of the farms of Kent, Surrey, and Devonshire,* the British Island would depend on foreign countries for all necessities of life, and *there would be no room for the British workman.* (Pp. 140-142.)

The italics are not in the original. Our own leading men who have seriously studied the question—the *obiter dicta* of those who have not go for nothing—have reached practically the same conclusion. Let the warnings of Lord Rosebery, of Dr. Haldane, of Mr. Chamberlain, of Professor Pearson, be read together with the above, and it will be seen that there is something more than the raving of alarmists in the testimony that we *must repair the educational indifference of the past or submit to national decay.* [Chap. IV, sec. 2, p. 16.]

Bearing in mind that technical education in New South Wales is in a worse condition than it is in England, the question of a return to an unrestricted system of apprenticeship instead of establishing a forward movement by founding schools of the

---

[1] London, Hurst and Blackett, 1904.

[2] For the information of those who have not read Dr. Peters' work, it may be stated that it is, taken as a whole, highly appreciative of our land, people, and political ideals.

[3] "England and the English," p. 257.

[4] *Ibid.*, p. 258.

the thorough type, growing up all over Continental Europe and in America, is no insignificant one. It would be suicidal to make such a return, and persons who recommend it are ill-advised, and cannot be other than ignorant of the facts which should be taken into consideration.

13. *The Attitude of Labour.*—It is deeply interesting to notice that in Europe the attitude of labour toward the highest type of technical instruction is sympathetic, not hostile. The daily toil of the workman has been, to some extent, lightened by the development of technology. The conditions under which work is now done and the interest in the work itself are rapidly improving. It is not surprising therefore to find in Europe that technical instruction is sometimes subsidised by organised labour, and sometimes even wholly given through labour associations themselves. [*See* Chaps. VI and IX.] The recognition of the perpetual danger of war—and of the significance of national efficiency, both general and industrial, in regard thereto—has brought the question of the subordination of class interest to national interest more vividly before the popular mind throughout Europe than it has here. In time of war great distress would probably prevail, even with the victorious side; and any policy or any party which neglects to take account of the national welfare, in such a way as to modify class-egoism, till its demands conform to the conditions of general well-being, is calculated to overthrow even the egoistic advantages to which its short-sightedness has given undue prominence.

Ultimately the well-being of every class is consistent only with great efficiency in production, that is with production, not only well-balanced as regards its several elements, but also of such quality as to make it universally acceptable.

Australia is a country which has its own industrial and commercial problems to solve. Its limited and uncertain rainfall makes the problem of its agricultural and pastoral exploitation one of more than ordinary difficulty. To hold our own in the universal competition we need to be, not less well educated generally and technically, but better educated than the inhabitants of Europe.

European organised-labour has recognised that national efficiency is an essential factor of well-being, not merely of the whole, but also of itself. So also in America. More and more is it perceived that no country, which is to hold its own in the march of modern civilisation, or in the competitions and rivalries of nations, can afford to neglect adopting that scheme of technical instruction which creates in the shortest time the most accomplished type of workman.

14. *Concluding Remarks on Technical Efficiency.*—Our educational policy ought to be shaped quickly, if it is to compare with that of America or Continental Europe, and on lines that will make it a peer of the systems of those countries: in other words, the sooner we get thoroughly systematic technical schools the better. We must let that point of view, which rises superior to individual interest, dictate our policy.

The holding of examinations to force up the work of schools is an educational scheme that has been utterly condemned by competent critics. A short-sighted and egoistic policy demands that we shall retain the system of lengthy apprenticeship, with some supplementary instruction in a school of a more or less theoretical character. Our commercial men are asking, not that commercial schools of the European type should be established, but are content that the University should hold examinations, for which pupils will, as usual, cram themselves.

The sooner we decide that all our schools shall be of the thorough type growing up in America and Continental Europe, the sooner will we reach the only path of national safety, a lesson which recent events in the East should assuredly teach us.

The notion, commonly held, that the mere fact of the University holding examinations to determine the fitness of candidates in various subjects, will in time force schools to efficiently teach them, is responsible for many of the defects in our educational status. What is needed for a radical advance therein is a more vivid recognition of the need for thoroughly trained teachers, in each subject of instruction, well-organised curricula, and properly-equipped schools. We have many earnest and capable teachers prepared to make the necessary sacrifices and endowed with the requisite enthusiasm, but the machinery and opportunity for their thorough training is as yet lacking, our curricula and equipments need only be compared with those of Europe to make manifest the present need for advancement.

The

The way to improve education, technical or other, is not by raising the difficulty of public examinations—that only ensures more dexterous cramming—but by more carefully organising our curricula, by more widely educating and training our teachers, by giving them more opportunity for specialising in teaching, and by affording them the necessary material assistance in the way of apparatus and other aids to teaching.

All forms of agricultural, commercial, industrial, professional, or other technical education can be made excellent only by creating *special schools* for them, properly equipped and staffed with specialists. This proposition must be translated into a concrete fact if we are to have technical efficiency. It cannot be attained by the holding of public examinations by the University, to determine, for example, efficiency in commercial or other forms of technical knowledge. That course will only accentuate the tendency of schools to become "jacks" of all educational method and masters of none. We need only compare local ideas of commercial efficiency with those obtaining in Europe to recognise this.[1]

We cannot too strongly enforce the point that the educational and technical efficiency of Europe has been attained, not by tempting the one class of schools to teach everything, but by creating special and thoroughly organised and equipped schools.

One point, in conclusion, should be noted, viz., that the most efficient system is unquestionably the one for adoption. Those who have a pecuniary interest in maintaining the apprenticeship system, may be reminded that the system which is alone consistent with the general welfare of a country is the best for all, for the most efficient system means increased opportunity for participating in the consequent increase of wealth and general advantages, not for some but for all. The more intelligent class of employers are beginning to recognise that the mere loss of the premiums and labour of apprentices is of no moment compared with the benefits to be derived from utilising the labours of thoroughly-trained workmen.

Those who are prepared to sacrifice the national well-being for personal advantages of a minor order, should, of course, not be heard on the question of the best means of making us as a people technically efficient. The change cannot, of course, be made instantly, but it will be well if, simultaneously with a sufficient raising of the plane of instruction for apprentices, we establish also that type of systematic technical education, which is found in apprentice-schools, schools which aim at turning out very highly trained and properly educated workmen. It is only by adopting the best scheme that we can hope to take our place in the great rivalries of industry and commerce, which every intelligent critic of world-movement and *Welt-politik* sees to be inevitable.

---

[1] On the day this was written, it was stated in the Press, that foreign progress in commerce in the East was due to the thorough learning of oriental languages, and the establishment of a Chair in the University therein was recommended. It is thorough conversational teaching that is valuable; the function of a chair in the University is to increase the qualifications of the instructors, rather than to afford conversational practice.

IV.

MANUAL TRAINING IN RELATION TO TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—Manual training of an elementary character was dealt with in the Interim Report on Primary Education. [See Summary, IV, sec. 12, pp. 30, 31: IX, sec. 5, (22) to (25), p. 61: XI, p. 80. Body of Report, Chap. XVIII, pp. 167–173: Chap. XIX, secs. 1–12, pp. 174–180, Chap. LVII, sec. 7, pp. 489–490.] In some form, such training is to be found in the educational systems of all countries, and also in New South Wales, though at present it is but very weakly represented in this State.

It exists in two forms; one is little better than the teaching of ordinary carpentry, etc.; this may almost be called trade teaching; the other is *educative manual training.* It is with the latter alone that we need concern ourselves at the present moment.

The theory of educative manual training, and of that form of it which is known as Sloyd (wood and metal), has been discussed with sufficient fulness for present purposes in the Report on Primary Education. [Chap. XIX, Manual Training and Sloyd, secs. 1–12, pp. 174–180, see in particular secs. 5, 7, 8, and 11.]

Some further reference is made in this Report particularly to the higher reaches of the subject; see in particular Chaps. XXI–XXIV.

The object of educative manual training is to call into exercise the motor-activities of the pupils, and in so doing to give direction to their self-expression, in a series of disciplinary exercises, by which the pupils' sense and memory of form is developed and educated, and their muscular efforts are made obedient to their wills and educated.

Anyone who has observed the influence of a good system of manual training, the steady growth of muscular skill, the satisfaction afforded by creative effort, and who has considered also the opportunity it furnishes for applying arithmetic, geometry, drawing, etc., has no doubt as to its educational value.

2. *Continuity in Manual Training.*—The fundamental principle on which Froebel laid stress, viz., voluntary self-activity (Selbsttätigkeit), applies just as truly to primary, secondary and higher education as it does to the infantile period. The co-ordination of drawing with "paper-cutting and folding" exercises, the creation of designs from certain forms of cuts, the use of cardboard, etc., may be so ordered as to very considerably advance the pupils in manual skill, and awaken their genius for design.

Obviously there should be no cessation of such work on entry into the elementary school and passage through the primary school. It is desirable, therefore, that the paper, cardboard, and similar exercises should be carried on in the primary school, up to the time that the Sloyd or similar work is undertaken. This light manual work should be followed by wood-work (träslöjd and snickerislöjd) and metal-work (metallslöjd). Such work, *if carried out under competent direction,* will

will be educative in the highest degree, and will prepare the pupils for technical education of a more advanced character. In Sweden the Sloyd instruction is usual for pupils of from 10 to 14 years of age.

The higher manual training schools now being organised in Canada, and already fairly widely organised in the United States, are schools in which the general educative element is really fused with the elements of manual training of a trade character. It is by no means, however, mere trade teaching. This is as it should be, but it ought to be carefully observed that the practical side of technical instruction in properly staffed technical schools is always *educative*. The employment of mere tradesmen as teachers is unsatisfactory, and is everywhere discountenanced. Every instructor, whether in the lecture room, the laboratory, or the workshop, should be an educationist, *i.e.* a student of the theory of pædagogy, and a *teacher*, not merely an operator or workman.

In every country, difficulty has, of course, been experienced in obtaining such a class of teachers at the initial stages of technical education, and even when directed by a technological expert, the beginnings are far from satisfactory for this reason. This will explain, in part, the unsatisfactory character of technical education in this State.

3. *Inclusion of Higher Forms of Manual Training in Secondary Schools.*—Every student of the physical sciences, and every mechanician, will recognise at once the value of manual training of an advanced character, which might be taken during the period of the career in the secondary school. The question of the function of "Manual Training High Schools," and of manual training *in* high schools, has been very ably discussed by Charles B. Gilbert, quite recently, at St. Louis.[1] Mr. Gilbert contends that "*opportunity to pursue manual training as a cultural study should be offered to all secondary students,*" and he argues that when manual instruction is given in a secondary school it tends to accentuate its educational character, and to prevent it degenerating into a form that might be expected to be found in mere trade schools.

Professor C. M. Woodward, Director of the Manual Training School of the Washington University, St. Louis, Missouri, urges, however, that *attendance at a specially organised manual training school is preferable,* because the equipment can be made more complete, and the whole scheme of instruction can be better correlated.[2] Dr. W. T. Harris' view, both eleven years ago and now, is that "a manual training school, side by side with the high school, as an independent institution" is what is wanted. The view, that the manual training school is needed, is supported by President D. S. Jordan of the Leland Stanford University, by President Eliot of Harvard University, by the late Professor J. B. Johnson, by Dr. Belfield, Director of the Chicago Manual Training School, and one of the Deans of School of Education of the University of Chicago, and by a number of others. The educational eminence of President Eliot and his reputation for wide culture command respect for this view.

4. *Influence of Manual Training as an integral part of General Education.*—The development of the executive, mechanical faculties, while it in no way hinders the others, undoubtedly tends to create independence of spirit, and an appreciative attitude toward all manual effort. Probably most people who have given the subject consideration have recognised and regretted a widespread tendency to despise manual labour. At any rate, as the community stands at present, a considerable number of young people prefer to be clerks and to be occupied in similar light occupations—in which there is neither outlook nor hope of material advancement—to being concerned in more laborious occupations which promise ultimately substantial success. This tendency is at least partially corrected by manual training.

There are important scientific reasons for advocating manual training as a part of general education, which have a very direct concern with the question of increasing the technical efficiency of a people. According to the psychological researches,

[1] Journal National Educational Association, 1904, pp. 614-623.
[2] Loc. cit. pp. 619-623.

researches, the effect of motor-activity is to collaterally stimulate the sensory and other areas of the brain. Hence, not only are the various muscles concerned developed and trained, but the general sensory and intellectual powers tend to be enhanced. In other words, the effect of an educational system that takes proper account of motor-activity is to form a more all-round type of man, free from contempt of manual effort, muscularly efficient, and habituated to self-activity. Its function in establishing a sensory-motor co-ordination, of great value in technical pursuits, is too self-evident to require more than mention. The pupil who has passed through a good manual training school will be spared the necessity of doing much preliminary work which, at the present time, cannot be avoided, and is often very imperfectly done.

5. *Local Orientation of Manual Training.*—It was pointed out in the Commissioners' Interim Report that science teaching, etc., could, with great advantage, be locally orientated, so as to have the most direct application possible to the mode of life and occupation of the pupils themselves and their parents. [Interim Report, Summary, III., 13, pp. 20, 21.] It is obvious that the form of the manual training, including drawing, can be similarly treated. The idea is not novel. It is the basis of the suggestions of M. Léon Genoud, in his Report on the Educational Group of the National Swiss Exhibition at Geneva in 1896—*vide* pp. 422-6 therein. [Interim Report, Chap. XIX, sec. 11, pp. 179-180.] While the principles followed may, and ought to be, everywhere the same, the particular exercises to be followed can be orientated locally, without losing the *educative value* of the instruction, provided that the whole scheme be conducted by competent teachers, working under a competent director of the subject.

6. *Necessity for Thoroughness, and for Competent Direction of Manual Training.*—At the present time, a number of primary school teachers are undertaking, in an earnest and in many respects in an able way, to give instruction in various forms of manual training. Doubtless, the work is worth doing, and the splendid spirit of earnestness is a hopeful sign, and a source of gratification to all who recognise our educational needs, and the difficulties with which earnest teachers and educationists have to contend. It was the only course possible, as things are, to those who desire to bring the system of primary public instruction more into the line of progress, and such effort deserves every encouragement.

Nevertheless a note of warning is necessary. With our defective traditions as to the matter of previous professional training, the necessity of which was practically ignored, we have not hesitated to increase the load on the teacher, whose subjects, if thoroughly studied and taught, are already too wide-spread. We shall do well to remember that most of our teachers are self-trained; that, even to-day, with all the effort to advance, we have no professional training in general subjects comparable to that to be found throughout Europe and America. Even with far more lavish financial assistance than has yet been provided, we cannot give our incoming teachers such a training for years to come. Hence it is necessary to aim at *thoroughness* within a limited field.

There is a danger that they will now be expected to take up manual training generally, and that without proper education for such a task. In any case, to require them to become instructors in the whole range of manual training would be an error of policy. Teachers for higher branches of the subject ought to be *special* teachers. Nor will it do to employ merely expert workmen. The instructor must be an educationist, not a tradesman, a dictum which is in accord with the educational principles of every country of Europe and America, and in regard to which there is no difference of opinion among educational authorities.

It is worth recording that the work done under primary teachers who have given manual instruction, often betrays its limitations when compared with that done under properly-trained instructors. Pick up the chisels and tools of the pupil of the novice in manual instruction, and you find them imperfectly sharpened. Look at the postures of the boys at work, and you recognise the defective hygiene, for the physiology of the question has not been studied. Take notice of the benches, and you see that while the ingenuity of the teacher, restricted as he has been, is admirable, yet he

he has tolerated what the qualified instructor would not allow. Look at the gradation of exercises, and one sees at a glance their crudity as compared with Sloyd proper. Often the hard-working, self-sacrificing, and enthusiastic instructor is quite unconscious of his limitations. He gets results often gratifying, but not such results as are obtained by the properly trained teacher.

From the standpoint of educationists, *these matters are of moment;* with existing traditions and limitations, they pass. It is this lack of thoroughness which is leaving us behind in the race. What matter if a young lad has the condition of his tools somewhat defective; if his bodily posture at work is ill-advised; if the set of exercises is not perfectly organised? This is the attitude that is detrimental to us. Even the good tradesman is punctilious about such small matters as these, if he has been well instructed; much more the manual training expert. Ordinarily, neither inspectors nor teachers can satisfactorily help in the organisation of such instruction, for they themselves have no special knowledge of educative manual instruction; nor can they until they have acquired a much more definite knowledge than is readily attained under the conditions at present obtaining in the State. And the most competent among them recognise this thoroughly.

At the present time a species of laxity runs through our entire educational system, the natural consequence of the assumption, expressed in our failure to insist on previous professional training, that almost anyone can teach children. The notion that the mental and physical habits of children have to be rightly formed from the first days of school-life, though well understood by a large number of earnest officers and teachers, is not yet impressed on our educational system, as a system. That is what the present revision of our system aims at doing.

Every workman knows that the formation of good habits in the usages of his trade must start with the first exercises therein. Every physicist knows that manipulation must be well ordered from the first. Every chemist fully understands that good laboratory habits must be insisted upon, in the very first exercises in the laboratory. And if manual training is to yield its proper fruit, it must be taught from the beginning by a thoroughly trained instructor, and the whole scheme carried out without the liability to interference by ordinary departmental officers of primary instruction, who have not passed through a thorough course of instruction in educative manual training.

It is necessary to deal with manual training *thoroughly* from the start. If it is not so dealt with, it is liable to be brought into disrepute. By leaving it in the hands of persons incompetent to conduct it, we shall never appreciate it at its true value. Hence, in the schools of the larger centres, it ought to be well-organised from the beginning.

7. *Manual Training and Technical Education.*—Ultimately, of course, manual training in the primary school should be an integral part of the scheme of primary instruction, and should be under whichever officer discharges the duty of a Director-General of Primary Education. At the present time it is carried out under the supervision of the Technical Branch of the Department of Public Instruction, and directly under the general Director of Technical Education[1] (at present misnamed the "Superintendent"). It is desirable that manual instruction be thoroughly organised, and co-ordinated with the general scheme of technical education. It might then be relegated to the direct control of the department of primary instruction. In this way will it become a truly integral and therefore helpful part of that scheme of technical education so much to be desired for the rising generations of our State, and by the time it is organised there will, it may be hoped, be a large staff of special teachers who have had thorough professional instruction in manual training.

It has been urged by some teachers in this State, that manual training ought not to be a "subject," but should be undertaken in connection with primary school subjects. That may be done for the lower branches or for lower-grade schools.

No one who has seen properly organised manual training, carried out under competent instructors, will retain such an opinion. Universal genius is no more likely to be found in the primary school teacher of our State than elsewhere, and to

add

[1] The proper title of the office, and one which would not only describe its function, but be understood elsewhere, would be "Director-General of Technical Education."

add another "subject" to those already demanded of him, especially under existing conditions, will only accentuate the prevailing want of thoroughness. Rather let such instruction be given by persons thoroughly competent, and the thoroughness will tend to impress itself upon the pupil, and upon other elements of education.

There is an aspect of manual training which is engaging a good deal of attention in America at the present time. "The problem of the elementary school to day is . . . . to make the life of the school more real, more *an epitome of the kind of thinking, feeling, and doing that obtains in real life*," said Mr. C. R. Richards, of New York, some time ago.[1] Nature study, elementary science, and manual training are important factors in this problem. But if they are to have their full effect they must be started well, especially must manual training be taught thoroughly, for good hygiene, and good manual habits, both of which are important, can be secured *only by the diligent supervision of the trained teacher*, not by the teacher who is merely a rough carpenter, etc., or who has picked up his ideas as best he may. It is well to remember that in countries where the manual training is an integral part of the primary system, every teacher who undertakes to give such instruction has himself passed through a thorough and educative course. That is what is needed here, but it will require much more than a course of twelve months' training to attain to this.

The great advantage of commencing *thoroughly* is that our standard of effort is established on a good basis, and a slipshod scheme is likely to be subjected to severe criticism, or to bring what properly handled commands respect into discredit. In all reform or advance of our educational system, it is greatly to be desired that a passion for *thoroughness* will be characteristic; if it be not we shall remain behindhand.

---

[1] Handwork in the Primary School.—C. R. Richards, Director of Manual Training Department, Teachers' College, New York. Manual Training Magazine. October, 1901, pp. 1-11.

V.

V.

EXTENT OF THE INVESTIGATION OF THE TECHNICAL FORMS OF EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—In Division I of the Summarised Report here presented, some remark was made as to the range of inquiry into technical education [loc. cit., sec. 7, 8, pp. 8–11]. What was there stated afforded but a limited conception of the scope of the Commissioners' inquiry, and of the range of educational institutions which have been brought under review, in the attempt to treat the subject thoroughly. But since the value of a study of education depends in part upon actual visitation of schools in operation, upon an examination of their curricula and of their equipments both in personnel and material, as well as upon the range and thoroughness of a comparative study of these, it is necessary to amplify the statements already made.

A large number of the schools referred to by the Commissioners were actually visited, though the inquiry was by no means limited to these. Information was obtained in every possible way; the curricula of other schools were examined so as to get the benefit of a comparative study; and schools with special features were regarded as of more than ordinary interest. Hence, assisted by what was actually seen, and by information kindly furnished by *disinterested* observers, it became possible to make the study more comprehensive and thorough than would have been the case had only the schools actually seen been studied.

To those who imagine that personal visitation is wholly unnecessary it may be said, that the problem of creating an excellent educational organisation is admitted in all countries to be one of the greatest difficulty; that the method of America, and also of Europe, is to study closely the features of the educational developments of other countries by personal visitation; and that to see the educational institutions, methods, and equipments of Europe and America, is to annihilate at once such a supposition as that above suggested. Actual visitation is undoubtedly not supererogatory. The object of this division is to afford some idea of the range and extent of the investigation made by the Commissioners of the technical forms of education.

2. *Countries the Educational Systems of which were studied.*—Technical education, including agricultural, commercial, industrial, manual training, lower and higher technical and professional, trade teaching, etc., as organised in the following countries, was studied, viz.:—

America (United States).	England.	Norway.
Austria.	Finland.	Portugal.
Belgium.	France.	Russia.
Bohemia.	Germany.	Scotland.
Bosnia-Herzegovina.	Holland.	Slavonia.
Bulgaria.	Hungary.	Sweden.
Canada.	Ireland.	Switzerland.
Croatia.	Italy.	United States.
Denmark.	Japan.	Wales.

The study of some of the forms of education in the above countries would have been quite impossible but for the very generous assistance of educationists therein, the officials, the consuls, etc. In many instances their Excellencies the Ambassadors rendered most valuable assistance, acknowledgment of which has already been made in the Interim Report.

3.

3. *Lower Industrial and Technical Schools.*—The types of schools investigated were the following, viz.:—Manual training, artisan, trade, and other forms of technical school.

In *America* (the United States) such schools were studied in—Boston, Brookline, Brooklyn, Hoboken, New York, Philadelphia, Providence, San Francisco, Springfield, Tuskegee, etc.

In *Austria* the schools studied belonged to—Vienna in Austria, Cracow and Lemberg in Galicia, Trieste in Küstenland, Brünn and Olmütz in Moravia, Salzburg in Salzburg, Graz in Styria, Innsbruck in the Tyrol, etc.

In *Bohemia*, they belonged to—Pilsen, Prague, and Reichenberg.

In *Belgium* to—Antwerp, Bruges, Brussels, Ghent, Ostende, Verviers.

In *Bosnia-Herzegovina* to—Foca, Livno, Sarajevo.

In *Bulgaria* to—Routschuk, Samakow, Slivno, Trn.

In *Canada* to—Montreal, Ottawa, Quebec, Toronto, etc.

In *Croatia-Slavonia* to—Lika, Osijek, Otočac, Zagreb.

In *Denmark* to—Copenhagen, Fredericia, Frederikshavn.

In *England* to—Birmingham, Bradford, Leeds, Liverpool, London, Manchester, Newcastle-upon-Tyne.

In *Finland* to—Åbo, Helsingfors, Kuopio, Nikolaistad, Tammerfors.

In *France* to—Agen, Armentières, Besançon, Béziers, Boulogne-sur-Mer, Brest, Cette, Châlons-sur-Marne, Cluses, Epinal, Firminy, Fourmies, Grenoble, Le Havre, Lille, Limoges, Le Mans, Marseilles, Mazamet, Montbéliard, Morez, Nantes, Nîmes, Paris, Pont-de-Beauvoisin, Rennes, Rheims, Romans, Roubaix, Rouen, Saint-Chamond, Saint-Didier-la-Seauve, St. Etienne, Sedan, Troyes, Voiron.

In *Germany* to—Aachen, Berlin, Düsseldorf, Dresden, Darmstadt, Frankfurt, Hamburg, Hannover, Karlsruhe, Leipzig, Mainz, München, Strasburg, Stuttgart, and other towns.

In *Holland* to—Amsterdam, Alkmaar, Arnheim, Breda, Brielle, 's Gravenhage, Groningen, Haarlem, 's Hertogenbosch, Leeuwarden, Leiden, Purmerend, Rotterdam, Wageningen.

In *Hungary* to—Arad, Budapest, Felsobánya, Kassa, Kesmark, Kolozsvar, Nagyág, Nagyszeben, Narosvásárhely, Selmeczbánya, Szeged, Ujpest, Verespatak.

In *Ireland* to—Belfast, Dublin.

In *Italy* to—Bologna, Como, Florence, Genoa, Milan, Naples, Rome, Turin, Venice.

In *Japan* to—Tokyo.

In *Norway* to—Bergen, Horten, Kristiania, Kristiansand, Porsgrund, Trondhjem.

In *Portugal* to—Lisbon, etc.

In *Russia* to—Ivanovo-Vozniessensk, Kostroma, Lodz, Makarieff, Moscow, Saint-Petersburg, etc.

In *Scotland* to—Edinburgh, Glasgow.

In *Sweden* to—Borås, Eskilstuna, Norrköping, Orebro, Malmö, Stockholm.

In *Switzerland* to—Berne, Geneva, Lausanne, Winterthur, Zürich.

4. *Higher Technical Schools.*—Higher technical education, as organised in the higher technical schools, Universities, etc., of the cities named hereunder, was studied, viz., in—

America.—Ann Arbor (Michigan University), Berkeley (California University), Boston (Massachusett's Institute of Technology), Brooklyn (Polytechnic), Cambridge (Harvard University), Chicago (University), Hoboken (Stevens' Institute of Technology), Ithaca (Cornell University), Lafayette (Purdue University), New Haven (Yale University), New York (Columbia University), Philadelphia (University of Pennsylvania), Princeton (College of New Jersey), Terre Haute (Rose Polytechnic), Troy (Rensselaer Polytechnic), Worcester (Polytechnic), Washington (University), etc.

Austria.

Austria.—Brünn, Cracow, Czernowitz, Graz, Innsbruck, Lemberg, Vienna.

Bohemia.—Prague, Přibram.

Belgium.—Brussels.

Canada.—Montreal (McGill University), Toronto (University).

Denmark.—Copenhagen (University).

England.—Birmingham (University), Cambridge, Leeds, Liverpool, London, Manchester, Newcastle-upon-Tyne.

Finland.—Åbo, Helsingfors.

France.—Lille, Marseilles, Paris, St. Etienne.

Germany.—Aachen, Berlin, Darmstadt, Hamburg, Hannover, Karlsruhe, München, Stuttgart.

Holland.—Amsterdam, Delft.

Hungary.—Budapest.

Italy.—Genoa, Rome, Turin.

Japan.—Tokyo.

Norway.—Kristiania.

Russia.—Ekaterinoslav, Kharkoff, Kieff, Moscow, Riga, St. Petersburg, Tomsk, Warsaw.

Scotland.—Edinburgh, Glasgow.

Sweden.—Stockholm, Upsala.

Switzerland.—Berne, Geneva, Lausanne, Zürich.

5. *Agricultural Education, including Dairying, etc.*—Agricultural education in various grades was studied in a number of countries. The following list will give some idea of the purview of the subject:—

America (United States).—Berkeley (California), Cambridge (Harvard), Ithaca (Cornell), Lafayette, Michigan, Tuskegee, Wisconsin.

Austria.—Bruck an der Mur, Brünn, Czernichów, Czernowitz, Dublany, Eisgrub, Graz, Klosterneuberg, Lemberg, Mödling, Neutitschein, Ober-Hermsdorf, Prerau, Weisskirchen, Vienna.

Bohemia.—Chrudim, Kaaden, Prague, Raudnitz-Hracholusk, Tabor, Tetschen-Liebwerd, Weisswasser.

Belgium.—Avelghem, Bastogne, Bouchout, Borsbeke, Brugelette, Carlsbourg, Chimay, Dinant, Gembloux, Ghent, Grammont, Gysegem, Hasselt, Herve, Héverlé, Huy, Leuze, La Louvière, Nieuport, Oosterloo, Overyssche, Sottegem, Thielt, Vilvorde, Virton, Waremme.

Denmark.—Copenhagen.

England.—Newcastle-upon-Tyne.

France.—Bouguenais, Gorges, Noisy-le-Roi, Paris, Rennes, Versailles.

Germany.—Berlin, Bitburg, Brieg, Cleve, Dahme, Döbeln, Eldena, Flensburg, Gmünd, Hall, Heilbronn, Heilenberg, Helmstedt, Hildesheim, Herford, Hohenheim, Königsberg, Köstritz, Leonberg, Liegnitz, Lüdingshausen, Margrabowa, Marienberg, Margrabowa, Poppelsdorf, Ravensberg, Reutlingen, Rotweil, Rufach, Samter, Ulm, Umstadt, Varel an der Jade, Weihenstephan, Weilburg, Weinsberg.

Holland.—Aalsmeer, Alkmaar, Boskoop, Breda, Dordrecht, Goes, Groningen, Leeuwarden, Naaldwijk, Schagen, Sittard, Tiel, Utrecht, Wageningen.

Italy.—Milan, Perugia, Pisa, Portici.

Norway.—Aas, Kristiania.

Sweden.—Alnarp, Åtvidaberg, Björkfors, Halmstad, Hernösand, Jönköping, Kalmar, Luleå, Lund, Orebro, Skåne, Skara, Stockholm, Upsala, Ultuna, Vesteras, Visby.

Switzerland.—Auvernier, Berne, Ecône, Geneva, Lausanne, Lucerne, Moudon, Neuchâtel, Perolles-Fribourg, Rüti, Sonnenwyl-Fribourg, Sornthal, Strickhof, Vevey, Wädensweil, Zürich.

Wales.—Aberystwyth, Bangor.

6.

6. *Agricultural Engineering.*—Agricultural Engineering is becoming a definitely organised professional calling in many parts of the world, and courses in the subject are found in the majority of European countries and in America. It was studied as organised in the courses at the following places, viz. :—

America.—Berkeley, Cambridge, Ithaca, Lafayette, Madison, Newhaven, Philadelphia, etc.

Austria and Bohemia.—Cracow, Prague, Vienna.

Belgium.—Gembloux.

Denmark.—Copenhagen.

England.—Newcastle-upon-Tyne.

France.—Versailles.

Germany.—Berlin, Breslau, Giessen, Göttingen, Halle, Kiel, Königsberg, Leipzig, Munich.

Italy.—Milan, Pisa, Portici.

Sweden.—Alnarp, Ultuna near Upsala.

Switzerland.—Zürich.

7. *Forestry Schools.*—Courses in Forestry are very thorough in Europe, and America has lately recognised the necessity of developing similar courses for the thorough professional training of foresters. No one who studies the question can doubt that the subject needs very much more serious attention in the State than has yet been given to it. Natural reafforestation is not sufficient. The courses studied are as follows :—

America (United States).—Cornell.

Austria and Bohemia.—Elementary Schools of Forestry are to be found in Steiermark, Krain, Tyrol, Bohemia, Moravia, and Galicia. Secondary Schools of Forestry :—Lemberg, Weisskirchen, Weisswasser. Higher forestry course :—Vienna.

Denmark.—Copenhagen.

France.—Versailles.

Holland.—Wageningen.

Norway.—Kristiania.

Sweden.—Kloten, Omberg, Stockholm.

Switzerland.—Zürich.

8. *Commercial Education.*—Commercial education is acquiring greater prominence in all countries. It is generally recognised that the subject has been seriously neglected in Great Britain, but steps are being taken to repair this. Commercial education, as organised in the following places, was studied :—

America (United States).—Ann Arbor (Michigan University), Brooklyn, Cambridge (Harvard), Chicago, Madison, New York, Philadelphia, San Francisco.

Austria and Bohemia.—Higher Commercial Education :—Aussig, Brünn, Chrudim, Cracow, Gräz, Innsbruck, Königgrätz, Lenz, Olmütz, Prague, Prossnitz, Reichenberg, Trieste, Trient, Vienna.

Secondary or Commercial day-schools:—Bosen, Brünn, Brüx, Gablonz, Gräz, Hořitz, Klagenfurt, Kolin, Lemberg, Mährisch-Ostrau, Melnik, Olmütz, Pilsen, Prague, Rieden, Saaz, Salzburg, Sambor, Smichoff, Teplitz, Troppau, Wels.

Continuation schools for commerce.—These are very numerous in Austria. There are no less than 15 in Vienna itself, and about 61 in Bohemia.

Belgium.—Antwerp, Brussels, Ghent, Louvain, etc.

Finland.—Helsingfors.

France.—Agen, Béziers, Bordeaux, Boulogne-sur-Mer, Brest, Cette, Fourmies, Grenoble, Le Havre, Le Mans, Lille, Limoges, Lyons, Marseilles, Mazamet, Montpellier, Nancy, Narbonne, Nîmes, Paris, Rheims, Rouen, etc.

Germany.—Berlin, Cologne, Dresden, Leipzig.

Hungary.

Hungary.—Arad, Brassó, Budapest, Debreczen, Késmárk, Kolozsvár, Nagy-Kanizsa, Sopron.

Holland.—Alkmaar, Almelo, Amsterdam, Bois-le-Duc, Breda, Delft, Deventer, Enschedé, Groningen, 's Gravenhage, Leeuwarden, Maastricht, Nijmegen, Rotterdam, Sneek, Utrecht, Zutphen.

Italy.—Como, Florence, Genoa, Milan, Naples, Rome, Turin, Venice.

Japan.—Tokyo.

Norway.—Kristiania.

Russia.—Ekaterinburg, Odessa, Moscow, St. Petersburg, Taganrog.

Sweden.—Gefle, Gothenburg, Stockholm, Sundsvall.

Switzerland.—Berne, Bellinzona, Geneva, Lausanne, Neuchâtel, Winterthur.

United Kingdom.—Birmingham, Leeds, Liverpool, London, Manchester, Edinburgh, Glasgow, Dublin.

9. *Special Schools of various Types.*—Included within the technical schools referred to in the preceding sections are various special schools to which a word of reference may be made.

Brewing Schools are found in Austria, Germany, etc. Special interest attaches to these, because the empirical knowledge of the United Kingdom, a few years back, was in advance of that of Continental Europe. Our manufacturing methods were learnt empirically by Germans and Austrians, but resolved by scientific study into systematised knowledge. This, it has since been recognised, gave the advantage to Continental Europe, and one of the latest features in technical education is the establishment of the British School of Brewing in the Birmingham University, the laboratories of which are practically modelled upon those of Europe. Thus in future the art of brewing will be founded upon scientific knowledge in the United Kingdom as well as in Continental Europe.

Another feature worthy of mention is the creation of a *School for Leather Industries*, a special feature of the Yorkshire College. A much finer school exists at Wermelskirchen, in Germany. The creation of such a school in this State is important.

Weaving Schools were visited by the Commissioners in several places. They also may become important for Australia.

The judgments of the Commissioner are based upon a comparative study of these various schools, together with such observations as could be made during the visitation of some of them.

VI.

TECHNICAL EDUCATION IN NEW SOUTH WALES.

[G. H. KNIBBS.]

1. *Introductory.*—In the elementary schools of New South Wales, taken as a whole, there is as yet no adequate foundation, in the way of scientific instruction, nor in the way of manual training, on which the superstructure of technical education can be built. There are, as yet, but few properly organised kindergartens in the State; educative manual training has not been generally established, and where it exists it is imperfectly organised; and further, but few schools, State or other, are fitted up with the necessary aids for instruction in natural science. One sees but rarely a school-museum worthy of the name, or a physico-chemical, or other laboratory.

There is, it is true, a kindergarten society in Sydney, and also one in Newcastle, supported by the subscriptions of persons interested in such work, and by State subsidy. These societies conduct kindergartens, and train teachers for kindergarten work on approved lines. But, valuable as such work undoubtedly is, it is a negligible quantity in relation to what is needed for the total school population.

At various schools, also, earnest and progressive teachers have given scientific instruction, or have prosecuted certain forms of nature study, and have developed school-gardens; or they have established more or less well-organised forms of manual training, including modelling, cardboard work, and woodwork. In many instances too, personal devotion, natural ability, and self-culture, have done much to minimise the absence of those advantages which arise from the professional training provided in other parts of the world; and good results have been attained. The spirit of initiative and the enthusiasm which has been thus manifested disclose how much may be hoped for, when the organisation of our educational system is completely brought into line with modern educational methods; at the same time, it makes evident the *weakness of existing preparation for technical education.*

Although the movement referred to, viz., the development of manual training, science teaching, etc., is by no means very recent in many instances, it has, until quite recently, received but scant encouragement; hence, when the facts are taken *in globo*, it remains true, that so far as the proper foundations for technical education are concerned, they have not yet been laid in the existing system of public instruction. And in this respect the State is at a disadvantage, and will so remain until the kindergarten and primary systems have been properly developed. When the reform suggested *has* been achieved, then, and not till then, will the first great requisite for good technical education, viz., proper preparation in the elementary school, be to hand.[1]

It is important to take account of the fact first stated. Technical education, to fulfil its function and to achieve what it should, must be based upon such preparation as has been referred to; and we cannot expect to see our technical system yield its proper fruit, or give results equal to those of Europe, until the whole educational system is more perfectly organised under the movement now being initiated. The secret of European advance in technical matters lies, not merely in the technical system itself, but in the completeness and efficiency of the educational organisation as a whole; upon the fact, also, that every lower form of education is profoundly influenced by the higher forms, and ultimately by the universities themselves.[2] In

[1] This discloses the significance of the present reform movement, to perfect which, however, much more liberal educational expenditure is necessary.

[2] It is essential that the spirit of higher education should permeate the whole.

In the educational system of this State the control has hitherto been a subversion of the natural order. The influence of the highest form of education has not been paramount, nor has the influence of secondary education been greater than that of primary. The characteristic of the higher European educational institutions is their freedom from the domination of tradition, their initiative, their instinct of research, their unqualified respect for original investigation in every department of knowledge, literary, scientific, or professional. To this is due their power. If we can acquire the spirit of the European University, with its student-freedom, its passion for research, its power to infuse the spirit of higher educational effort into all lower forms, then technical, secondary, and primary education will be much more healthy and vigorous, will advance more satisfactorily, and become more completely harmonized.

2. *Forms of Technical Education in New South Wales.*—Technical education, at the present time, is somewhat peculiarly organised in this State. In a few of the elementary, or primary schools—the "public schools"—manual training of a very elementary type is given, outside the regular school hours, under the technical branch of the Department of Public Instruction. Subjects such as elementary science[1], shorthand, typewriting, book-keeping, and elocution are also taught in the same manner. The instruction is given by special teachers, who are, more or less, proficients in the several subjects; but who are not, except in rare instances, systematic students of pædagogical theory.

Instruction in cookery is also given in some of the public (primary) schools, but directly under the primary branch of the Department. And in some primary schools manual training, and even very elementary agriculture, are taught by the teachers themselves, they having endeavoured, in a more or less perfect way, to specially equip themselves by study and practice.

Teachers of cookery, under the direct supervision of the Primary Education Branch of Public Instruction—at least in some cases—conduct cookery classes for adults, known as "technical classes," though not under the officer directing technical education.

The Technical Branch of Public Instruction deals with one great branch of lower technical education, the other is dealt with by the Department for Mines and Agriculture. The latter has initiated schools for instruction in agriculture, dairying, etc., which are doing excellent work, but under limitations which will be referred to later.

The higher forms of technical and professional education are undertaken by the University. Excluding dentistry, law, medicine, and surgery, these are civil engineering, mechanical and electrical engineering, and mining engineering.

The history and details of the various forms of education will be briefly referred to hereinafter.

3. *History of Technical Education under the Public Instruction Department.*—The committee of the "Mechanic's School of Arts" of Sydney, as far back as 1865, initiated a movement for the establishment of technical classes in connection with that institution, Mr. Norman Selfe taking an active part therein.

The classes were inaugurated as follows:—

Mechanical Drawing ...	1865	School of Design	1870
Mineralogy and Geology ...	1869	Chemistry	1871

In 1873, Mr. E. Dowling, afterwards Secretary of the "Board of Technical Education," proposed the founding of a "Working Men's College," and, in 1878, Parliament granted £2,000 towards this object, £5,000 having also been contributed by the members of the School of Arts.

The present organisation really dates back to 1883, when a Technical Education Board was appointed, as a result of suggestions made at a Technological Conference held in 1879 under the presidency of the late Sir Henry Parkes.

Technical classes, under the auspices of the Board referred to, were held in the School of Arts, in the Technical Institute of Sussex-street—a building rented for the purpose—and also in the public school, of Castlereagh-street.

In

[1] For example, at Sydney, Bathurst, Broken Hill, Goulburn, Newcastle.

In 1884, itinerant lecturers were despatched to give addresses in the larger country centres of population, on the importance of Technical Education, the result of which effort was the establishment of country branch colleges. Instruction of a scientific or technical character was given in several places in the same and following year, viz., as follows:—

Newcastle—December, 1884: Lecturer in Geology and Mineralogy appointed.
Bathurst—April, 1885: Lecturer in Geology, Chemistry, and Mineralogy appointed.
Goulburn—August, 1885: Science and Art Master appointed.
West Maitland—September, 1885: Lecturer in Model, Perspective, and Geometrical Drawing appointed.

Technical Education was conducted under the Board of Technical Education until November, 1889, which was dissolved by proclamation; the work was then carried on as a branch of the Public Instruction Department. This important change was brought about by the Hon. J. H. Carruthers, then Minister for Public Instruction.

New buildings for technical instruction were erected as mentioned in the following schedule, viz.:—

Sydney,	8th February, 1892	Bathurst,	30th June, 1898
Maitland,	1st September, 1890	Albury[1]	— Jan., 1899
Newcastle,	20th February, 1095	Goulburn,	8th March, 1902
Broken Hill,	1st March, 1898	Lithgow,	22nd Nov., 1902.

Besides the colleges specially built for technical instruction, buildings are rented at Granville and Petersham, and are provided free of charge at Balmain, Hillgrove, and Maclean.

Technical classes are given in a number of public schools, *e.g.*, the public schools at

Ashfield	Newtown	Ryde	Surry Hills
Lindfield	North Sydney	Waverley	

for the suburbs of Sydney, and at

Armidale	Dapto	Kurri Kurri	Seaham
Albion Park	Dubbo	Minmi	Singleton
Blayney	Grafton	Morpeth	Teralba
Carr's Creek	Hinton	Mount Kembla	West Wallsend
Clarencetown	Helensburgh	Orange	Wollongong
Cobar	Keiraville	Plattsburg	Woonona.
Corrimal	Kiama	Raymond Terrace	

Had they been constructed as in Europe, the public-school buildings might well have been used in the evenings for technical instruction, and many of the newer school buildings in the United Kingdom are so used. With the very imperfect class-room arrangement adopted it is impossible to give efficient instruction in many subjects, and the seating arrangements are very inconvenient.

4. *The Technical College Buildings.*—The Technological Museum, and the main building of the Technical College at Ultimo, Sydney, are buildings of fine appearance, and are somewhat expensively constructed. They are, however, not well-designed as regards their purpose, and the group of associated buildings have been erected absolutely without regard to a general plan. This is greatly to be regretted, for the buildings are too good to sacrifice; and owing to the fact that they have been erected without regard to uniformity, and without any attempt being made to constitute them integral elements of a scheme, it is now practically impossible to unite them under any plan for general improvement. A fine building thoroughly adapted to its purpose could have been built for less money than has been expended.

The other colleges shew analogous defects. These have arisen through the fact that those responsible for the design of the colleges were not technologists competently informed as to their function. It

[1] Old primary school premises only.

It is important in future that each building for technical instruction should conform to a general plan of a comprehensive character. This should be prepared initially, and whenever the permanent building cannot be erected from the outset, the temporary structures should in no way hamper the final project.

Anyone who understands how a technical college should be designed cannot help feeling profound regret at the want of knowledge and foresight exhibited in our colleges; and their limitations should be a sufficient warning against the repetition of mistakes of the same kind.

5. *The Courses and Curricula of the Colleges.*—The calendar in which the details of the courses of instruction and general regulations, etc., are indicated is an octavo volume of about 172 pages [for 1904].

Part of the work of the College has been divided into so-called *Departments*, viz.:—(1) Mechanical Engineering; (2) Electrical Engineering; (3) Agriculture; (4) Training in Sheep and Wool; (5) Chemistry and Metallurgy; (6) Geology, Mineralogy, and Mining; (7) Applied Physics; (8) Sanitation; (9) Architecture; (10) Art; (11) Industrial and Decorative Art; (12) Domestic Economy and Cookery; (13) Manual Training.

Besides these it has what are called *Classes*, viz.:—(14) Farriery; (15) Metallurgy; (16) Assaying; (17) Slide Rule; (18) Electrical Engineering (evening); (19) Mathematics; (20) Masonry; (21) Bricklaying; (22) Stone and Marble Carving; (23) Letter-cutting; (24) Carpentry and Joinery; (25) Staircasing and Hand-railing; (26) Advanced Joinery; (27) Turning; (28) Carving; (29) Cabinet-making; (30) Printing (composing); (31) Printing (machining); (32) Lithography; (33) Photo-lithography; (34) Dressmaking; (35) Teachers' Course in Dress-making; (36) Millinery; (37) Penmanship; (38) Correspondence; (39) Shorthand; (40) Physiology; (41) Elocution; (42) Coal-mining; (43) Mine-surveying; (44) Wool-classing (evening); (45) Mining; (46) Dairy Science; (47) Physiography; (48) Petrology.

Some of the "Departments" embrace a number of subjects or even courses. These will be sufficiently illustrated in the programmes immediately following, in which the figures represent hours per week. It may be mentioned that the year is divided into three terms of about fourteen weeks each.

Subjects.	Years. I.	Years. II.	Years. III.	Subjects.	Years. I.	Years. II.	Years. III.
			Course in Engineering.				
Mathematics	6	4	3	Applied Mechanics	...	2	2
Physics	5	...	...	Electrical Engineering	...	7	8
Chemistry	3	3	...	Patternmaking	...	E3 M4	...
Mechanical Drawing	6	5	M6* E 4	Mechanical Workshop	...	E6 M12	E9 M15
Freehand Drawing...	2	...	...	Metallurgy or Sanitary Engineering	...	...	1
Model Drawing	2	...	...	Ironfounding	...	...	1½
Plane and Solid Geometry ...	4	...	...	Blacksmithing	...	...	1½
Carpentry	2	...	...				
			Courses in Agriculture.				
Agriculture (Elementary)... ...	1½ 1½[1]	...	...	Farriery	1¼	...	...
				Botany	2	1	...
„ (Advanced)	...	1½ 1½[1]	...	Veterinary Science...	1	...	...
			Course in Sheep and Wool.				
Sheep and Wool Day Classes (Special Course)	30	...	...	Wool Sorting	4	...	...
			Course in Chemistry and Metallurgy.				
Practical Chemistry	9 10[1]	9 10[1]	...	Organic Chemistry	2½	2½	...
Theoretical Chemistry	1	1	...	Assaying	6 7½[1]	6 7½[1]	...
Chemistry (Public School Teachers)	2½	...	...	Metallurgy	1	1	...
			Course in Geology, Mineralogy and Mining.				
Geology Lectures	1	1	1 (Adv.)	Mineralogy Lectures	1	1	...
„ Practical Classes	...	2 11[1]	2 11[1]	„ Practical Classes ...	...	2 11[1]	...
				Metalliferous Mining	1	...	...

M denotes work for Mechanical Engineering students.
E „ „ Electrical „ „

* Machine design.
[1] Denotes work for Evening Classes.

Subjects.	Years. I.	II.	III.	Subjects.	Years. I.	II.	III.	IV.
Courses in Mechanical Engineering.								
Mechanical Drawing	10	10	10	Boilermaking	3½	3¼	...	
Applied Mechanics	1	1	...	Fitting and Turning	10	10	...	
Blacksmithing	8	8	8	Ironfounding	4	4	...	
Patternmaking	4	4	...	Slide Rule	3	...	...	
Course in Electrical Engineering and Physics.								
Electrical Engineering Practice ...	6	2	2*	Physics Lectures	2	...	...	
" " Theory ...	1	1	1*	" Practice	4	...	...	
Courses in Mathematics.								
Arithmetic and Mensuration ...	1	1	...	Algebra	1	1	...	
Geometry	1	1	...	Trigonometry	1	1	...	
Course in Sanitation.					I.	II.	III.	IV.
Sanitary Engineering—Course A...	1½	...	...	Sanitary Law, etc. (2nd and 3rd terms).	1	...	...	...
" " " B...	1½	...	...	Inspection of Meat and Animals...	1	...	...	...
" " " C...	1½	...	...	Plumbing	4, 6[1]	4, 6[1]	4, 4[1]	4, 4[1]
" " " D...	1½	...	...					
Course in Architecture.					I.	II.	III.	
Trades Drawing	6	6	...	Carpentry and Cabinetmaking, Advanced Joinery (Special Course)	25, 8[1]	8[1]	...	
Architectural Drawing ... / " Design ...	6	6	6	Handrailing and Staircasing ...	6	...	...	
Building Construction	1	1	1	Manual Training	4	4	4	
Architectural History	1	1	...	Wood and Chip Carving	10, 2[1]	10, 2[1]	...	
Principles and Practice of Architecture.	...	...	1	Wood Turning	4	...	...	
Quantity Surveying	2	...	...	Bricklaying	4	...	...	
Courses in Art.								
Plane and Solid Geometry ...	4, 4[1]	4, 4[1]	4, 4[1]	China Painting & Glass Painting	8, 2[1]	8, 2[1]	...	
Perspective Drawing	4, 2[1]	4, 2[1]	...	Landscape Painting	4	4	...	
				Animal Painting	2	...	...	
Model and Object Drawing ...	6, 4[1]	6, 4[1]	...	Still Life Painting	4	4	...	
				Life Painting	10	10	...	
Sciography	2	...	...	Modelling, Life	2, 2[1]	2, 2[1]	...	
Freehand Drawing...	8, 6[1]	8, 6[1]	8, 6[1]	" Antique	4, 4[1]	4, 4[1]	...	
Plant Drawing	2, 2[1]	2, 2[1]	...	" Ornament	4, 4[1]	4, 4[1]	4, 4[1]	
Black and White	2, 2[1]	2, 2[1]	...	Casting	2, 2[1]	2, 2[1]	...	
Antique (Drawing from)	4, 2[1]	6, 2[1]	...	Modelling, Public School Teachers	1	...	...	
Life Drawing	6, 2[1]	6, 2[1]	...	Casting, " "	1	...	...	
Flower Painting	4	..	...					
Course in Industrial and Decorative Art.								
House Painting	4	4	...	Art Decoration	6	6	...	
Graining and Marbling	4	4	4	Design	10	10	10	
Sign-writing	6	6	6	Illumination	6, 4	6, 4[1]	...	
Decoration	6	6	...					
Course in Domestic Economy.								
Cookery, Plain	16	...	...	Starching and Ironing	1	...	...	
" Advanced	4½	...	...	Domestic Economy	1	...	...	
Special Courses.								
Lithography and Photo-lithography	6	6	...	Art Needlework	1	...	...	
Printing (Composing)	4	4	4	Book-keeping	2	...	...	
" (Machining)	4	4	4	Penmanship	1, 2[1]	...	...	
Dressmaking	24, 2[1]	24, 2[1]	...	Shorthand...	4	...	...	
Millinery	6, 2[1]	...	...	Elocution	2	...	...	
				Physiology	1	...	...	

Whatever may be thought of the general scheme of organising the various courses, it is at once obvious that they cover a fairly wide range. 6.

* Honours. [1] Evening Classes.

6. *Do the Technical Colleges fulfil their function?*—It must be confessed that the reputation of the work of the College among practical men, however, is not what might have been hoped. There is a wide-spread conviction that competent tradesmen are becoming more and more scarce, and that this is in a large measure due to the defects of the provision made in the State for technical education, and to the defects also of the scheme of work in the technical colleges themselves. And making every allowance for prejudice it must be admitted that there is some ground for adverse criticism. A comparison of our technical colleges with the majority of those of Europe will satisfy any impartial critic that we have much leeway to make good. There is an obvious reason for the limitations of the technical system, which reason may now be mentioned.

The Department of Public Instruction as constituted up to the present time is essentially a department of primary instruction; even the total amount of secondary education given under its ægis is practically negligible as regards this aspect of the matter. In its own development, be it remembered, it had signally failed in three of the most fundamental elements, viz., (1) in its tradition as to how to train its teachers; (2) in its tradition as to how schools should be built and equipped; and (3) in its tradition as to what constituted a normal curriculum. It was hardly to be expected, therefore, that technical education, developed under its direct control and supervision, could be a complete success. The "Superintendent" of its technical branch was placed under the direct control of a chief inspector, whose experience and life-work were limited to the primary system itself! A system of technical education could no more thrive under such conditions than could a university. Such an administrative scheme was essentially defective, and it is necessary therefore that advanced forms of education, such as technical, university, etc., be removed absolutely from the control of those whose expert knowledge and authority must necessarily be restricted to matters concerning primary education. The administration of technical education should have been independent of the department of primary education, even had that department been developed on ideal lines, and been free from the grave shortcomings which have already been pointed out. With such shortcomings it is the more necessary.

Under the administrative scheme which has been in force, the heads of the technical system could not effectively represent their views to the Minister, nor even to the Under Secretary; their opinions had to filter through both the Chief Inspector and Under Secretary before they could reach the Minister. Thus the dominating influence was that of the primary schoolmaster, so that the technologist had to be governed by him! The situation is, of course, an anomalous one, and its incongruity has had much to do with the limited efficiency of the system of technical education as it stands at present.

It may be pointed out also that so slight has been the appreciation of the pressing importance of technical education itself, that the vote for it is, as pointed out [II, sec. 1, p. 14 hereinbefore], only $\frac{1}{28}$ of that for primary education! This is the condition of things to which the unique method of placing technical education under the ægis of primary instruction has led. For the technical system to fulfil its proper function, therefore, the old condition of things needs to be abolished, and in future it will be necessary to place the Director General of Technical Education[1] directly under the Minister.[2]

7. *Technical Education under the Department of Mines and Agriculture.*—Valuable instruction in agriculture, arboriculture, fruit culture, viticulture, general farming, and dairying, etc., is given in several centres, the chief one being, however, the Hawkesbury Agricultural College, at Richmond. The following list gives the order of the opening of the several establishments:—

Agricultural College and Farms.

Hawkesbury Agricultural College, and Associated Experimental Farms ... opened 10th March, 1891	Berry Dairy Stud Farm ... ...opened 1898
Wollongbar Experimental Farm ...opened 1892	Howlong Viticultural Station ... ... ,, 1900
Wagga Wagga Experimental Farm ... ,, 1893	Moree Irrigation Farm ... ... ,, 1900
Pera Bore Farm... ... ... ,, 1894	Belindigarbar Experimental Farm ... ,, 1901
Bathurst Experimental Farm ... opened Sept., 1895	Glen Innes Experimental Farm ... ,, 1902
	Cowra Experimental Farm ... ... ,, 1903

Two of these farms are of considerable size, for example, the Hawkesbury and Wagga Wagga Farms are each 3,500 acres in extent.

8.

[1] This is the proper title for the officer directing technical education.

[2] The organisation and development of primary education is a sufficiently large undertaking in itself, especially where reform has to take place, without saddling the department with work of a technical character.

8. *The Courses in the Hawkesbury Agricultural College.*—The primary object of the Hawkesbury College and Experimental Farm was to teach the science of agriculture and the associated sciences, with the object of qualifying the students for the profitable management of farms, dairies, orchards, or vineyards, either as proprietors or managers.

The course is two years, and the subjects studied are :—

Programme of the Hawkesbury Agricultural College.

Practical agriculture	Both Years.	Entomology	2nd Year.
Principles of Agriculture	„	Veterinary Science and Practice ...	„
Practical Chemistry	„	Book-keeping	„
Theoretical Chemistry	„	Mechanics	„
Botany	„	Heat	„
Arithmetic	1st Year.	Bacteriology	„
English	„	Meteorology	„
Surveying	„		

The syllabus of instruction covers the following subjects, viz. :—

General Agriculture, including also carpentry and blacksmith's work; erection of farm buildings, etc.
Fruit Culture, including conservation of fruits.
Viticulture, which does *not* however include œnology (wine production).
Seed Examination, and methods of sowing.
Experimental Crops, illustrating effect of fertilisers.
Animal Breeding, etc., viz., management and breeding of horses, cattle, sheep, Angora goats, pigs, poultry, ostriches, etc.
Agriculture, physiology, characteristics, and management of bees.
Dairying, including instruction of dairies, treatment of milk, manufacture of butter, cheese, etc.

Students makes *excursions* to various kinds of farms, to orchards, shows, etc., and do practical work *on the farm.*

A *special course in dairying* of six month's duration is given.

The practical work consists of farm dairy work, butter and cheese making, the general management of machinery and agricultural appliances; book-keeping and accountancy relating to dairy-farms, creameries, co-operative societies, etc.; veterinary work; laboratory work in agricultural chemistry; microscopic demonstrations in bacteriology; agricultural engineering and surveying; practical agricultural botany; practical exercises in connection with vegetable pathology; agricultural entomology; aboriculture; meteorology.

9. *The true Significance of the Course.*—The above course is a comprehensive one, but it is actually less thorough than would at first appear, owing to the insufficient preparation of many of the students, who have, in some cases, to be taught even elementary arithmetic! It is clearly important, in endeavouring to interpret any syllabus, to remember that its significance is limited by the actual state of preparation of the student on entrance thereupon. For the syllabus above given to be really what it professes, it is essential that the student's preparation should have included arithmetic, algebra up to quadratic equations, elementary trigonometry, elementary physics, elementary chemistry, elementary botany, elementary zoology, and that he should have had some manual training. Then a two-year course might cover the ground indicated with reasonable thoroughness. The full benefit of the course and its normal character will be more fully disclosed when the entrance conditions are what they ought to be, that is to say, when the primary school system of the State shall have been put on a better footing. The value of the work at the Hawkesbury College will be greatly enhanced in the future.

10. *Other Courses in Agriculture, etc.*—The Wagga Farm has (1) an agricultural and (2) a fruit-culture section. These deal with: (1) soil, methods of cultivation, drainage, agricultural implements, harvesting, preparation for market, use of natural and artificial manures, conservation of fodders, ensilage, storage of root-crops and of grain, the management of horses, cattle, sheep, pigs, poultry, etc., and elementary carpentry and blacksmithing, erection of farm-buildings, repairs to implements, harness, fences, buildings, etc.; and (2) soil and its preparation for various fruit-trees, cultivation, manuring, pruning, harvesting, packing, preservation by

by drying, canning, pulping, jam-making, etc., grape-culture for various purposes. The farm has about 1,200 acres for various crops, *e.g.*, good milling, drought-proof and rust-proof wheats, etc.; 100 acres for fruit-culture, including olive growing, the remainder of the farm being used for grazing.

At the Berry Stud Farm dairying is taught, also the breeding and management of pure-bred dairy cattle.

There are also special lecture-courses given of a restricted character on several subjects.

The above will give a sufficient indication of the kind of provision made for agricultural instruction in the State. [For a more complete account see Chapter XLIX, pp. 687–710, by Mr. J. W. Turner.]

It will be seen hereinafter that the scheme of agricultural education in New South Wales has neither the range, variety, nor thoroughness of that in Europe; of the great utility, however, of what does exist, there can be no question.

11. *Engineering Courses in the University of Sydney.*—The engineering courses in the University of Sydney are: (1) Civil Engineering; (2) Mining and Metallurgy; and (3) Mechanical and Electrical Engineering. They are set courses of three, four, and four years respectively, with practically no options, or opportunities of specialising within the range of each. For example, a civil engineer cannot specialise in architecture, though he includes that subject in his course of studies; nor is there a course in architecture itself. One who desires to be a mining engineer is compelled to be also a metallurgist, in fact there is more insistence on metallurgy than on mining engineering; and mechanical and electrical engineering must be taken together, though each branch in itself is large enough for specialisation. This policy of narrowly determining what shall be the line of work taken up by a student is not in the interests of thorough education. It would be much better were a larger number of options provided for, that is to say better results would be reached were our system modified as in America, to more closely conform to the ideal of "*akademische Freiheit.*"

It may be mentioned that there are no complete courses in chemical technology or applied chemistry, chemical engineering, or electro-chemistry, nor are there any in agricultural chemistry, agricultural engineering, marine engineering, agriculture, forestry, or commerce.

While the University has made provision for professional teaching in engineering—a branch of higher technical instruction—it has not yet outlined a policy for general higher technical education. Moreover, at the present time *the University admits no one to the regular course of studies—i.e., for graduation—who has not matriculated in Latin. In this respect it maintains an attitude from which practically all the Universities in the world have departed.* German and French, or Italian, languages are more valuable for engineering, and for technology generally, than Latin or Greek, and there is not time to read all.[1]

In the scheme of staffing there is only one professor of mathematics, pure and applied, one professor of physics, one of chemistry, one of geology, one of biology—which includes botany and zoology, one of engineering. Such "professors" devote the whole of their time to their professional duties.

Besides these there are "Independent Lecturers" for various subjects included in chemistry, biology, engineering, etc. These are in reality professors of their various special subjects, and in most parts of the world are so called. Both are responsible directly to the supreme authority of the University—the Senate—for their teaching and conduct, etc. In addition to these officers, there are assistant lecturers, demonstrators, instructors, etc.

If the University is to provide a more extended opportunity for obtaining higher technical education it will be necessary to greatly increase the staff, and to obtain the best results it will be also necessary to place the independent lecturers in a more assured position, and perhaps also confer a different title, so as to secure the highest type of teaching.[2] Every higher instructor on the University staff must have a secured position if he is to devote himself to becoming a proficient of the highest order in his special subject.[3]

12.

[1] This question is discussed in relation to Secondary Education in Chap. III, secs. 1–19, pp. 13–30, Report of the Commissioners mainly on Secondary Education, 1904. The conclusions are embodied in sec. 19, p. 30.

[2] Every "independent lecturer" should feel justified in devoting himself to his special subject. But to do this his position must be assured for life, as is the case with the "professors." In Europe the situation is much more advantageous for the whole professional staff.

[3] It is not proposed to discuss the scheme of the State University here, however.

12. *The Curricula in Engineering.*—The curricula in the several branches of Engineering have already bren referred to; they are as given hereunder:—

Programmes in Engineering, Sir P. N. Russell School, University of Sydney.

Subject.	Civil Engineering. Year (Total Hours). I.	II.	III.	Mining and Metallurgy. Year (Total Hours). I.	II.	III.	IV.	Mechanical and Electrical Engineering. Year (Total Hours). I.	II.	III.	IV.
Mathematics	190	150	...	190	...	...	...	190	150	40	...
Descriptive Geometry...	70	...	...	70	...	...	...	70	...	...	...
Applied Mechanics	60	...	...	60	...	...	...	60	...	...	...
Chemistry (Inorganic)	280	...	...	280	...	...	...	280	...	...	...
Quantitative Analysis...	...	...	...	...	330	...	...	...	...	60	...
Physics	130	180	...	130	120	...	...	130	180	...	...
Engineering Drawing and Design ...	180	180	270	180	170	210	...	180	180	100	...
Mechanical Engineering	...	150	...	...	100	80	...	...	150	220	40
Surveying	...	40	30	...	...	60	...	...	40	...	...
Civil Engineering	...	20	300	...	20	90	...	...	20	60	...
Architecture & Building Construction	...	...	40	...	...	20	...	...	...	...	...
Geology	...	...	100	...	100	80	...	...	...	...	...
Mineralogy	...	...	...	...	...	80	...	...	...	...	...
Practical Metallurgy and Assaying ...	...	...	...	...	...	100	720	...	...	...	...
Electrical Engineering	...	...	...	...	...	80	...	...	...	170	80
Mining	...	...	...	...	...	...	100	...	...	...	...
Metallurgy	...	...	...	...	...	...	60	...	...	...	...
Mining and Metallurgical Design ...	...	...	...	...	...	...	140	...	...	...	...
Mechanical Workshop Practice ...	...	...	...	...	...	...	...	...	270	...	...
Electrical Engineering Laboratory ..	...	...	...	...	...	...	...	...	...	...	330
Mechanical and Electrical Design ...	...	...	...	...	...	...	...	...	...	...	270

In the above curricula the remarkable feature is the prominence given to chemistry in the three engineering courses.

13. *General Remarks.*—No reference has so far been made to commercial schools: those which exist are in private hands, and teach commercial subjects rather than give an organised course in commerce. The Boys High School of the Department of Public Instruction bears the legend over the entrance "Boys Commercial High School," but it is not a commercial school in the European sense.

Briefly summing up the whole matter, it may be said that:—

(*a*) Higher technical education is greatly limited by the indifferent state of preparation of students on entrance, this in its turn being the result of the defect in our scheme of primary and secondary education.

(*b*) The forms of higher technical education are unduly restricted, there being too few options in the courses available.

(*c*) The numerical force of the teaching staff of the University on the technological and professional side is inadequate.

(*d*) The equipments for technological instruction are not yet adequate.

Technical education as organised under the technical college scheme, labours under several disabilities, viz:—

(*e*) Limited appropriation, viz., $\frac{1}{28}$ of what is expended on primary education, a sum which from any point of view is quite inadequate.

(*f*) Subjection to the influence and control of a department of primary education.

(*g*) The failure to supply a suitable primary education as a normal preparation, the lacking elements being specially physical science, manual training, and the development of the mental and physical self-activity of the pupil.

(*h*) Technical education is also very seriously hampered by the circumlocution of the administrative scheme. This evil will continue, and the expenditure for technical education will fail to produce its normal results until it is assured that the officer directing it and its whole administration shall be directly under the Minister.

VII.

HIGHER AGRICULTURAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—In its widest sense, agricultural education may be regarded as including all theoretical and practical instruction relating to general agriculture, arboriculture, horticulture, viticulture, forestry, general farming, the growing special crops, kitchen-gardening, the formation of meadows and pastures, dairying, the rearing of horses, cattle, sheep, poultry, etc., in connection with farming pursuits; in fact, every form of occupation of the soil for production of crops, fruit, flowers, or the raising of animals. It embraces, therefore, instruction concerning the operations subsidiary to these several things; concerning the machinery required; concerning the buildings necessary for harvesting, preparing, storing and handling of crops of various kinds; concerning drainage and irrigation; and, further, concerning the scientific principles and facts underlying the whole range of the subject.

Forestry is often considered to include pisciculture, and the general management of streams of water, lakes, etc.[1]

A complete system of agricultural education must, consequently, meet the needs of the following, viz. :—

(1) Instructors of the highest grade.

(2) Proprietors and managers of large landed estates; others who desire a high form of agricultural instruction—such as professional agriculturists, farmers and dairymen, professional foresters, agricultural engineers, etc.; and instructors for lower grades of agricultural teaching.

(3) Proprietors and managers of landed estates of moderate size, lower grade foresters, farmers, dairymen, etc.; and instructors of the lowest grade of professional instruction in agriculture.

(4) Proprietors, managers, and workmen of small landed estates, or those who intend to become such; teachers who desire to so orientate nature-study in the primary school, as to give some elementary notion of agriculture.

(5) Children in elementary or primary schools, in cases where it is desired to create a taste for agriculture, and to confer some elementary knowledge of natural science as applied therein.

There

[1] Thus, a forestry department may be known as "eaux et forêts.

There must, therefore, in a complete scheme, be teaching from the highest grade of University instruction in the subject[1], down to the most elementary form of instruction which can be found in the nature-study teaching of an elementary school; and throughout the whole range the instructors ought to be thoroughly trained for each grade of teaching, if success is to be assured.

2. *Importance of properly qualified Agricultural Instructors.*—To understand what is hereinafter outlined, it is well to bear in mind that throughout Europe great importance is attached to the thorough qualification of instructors. All forms of technical education may fall into disrepute, and disappoint everyone, not because they are faulty in principle, but because the instruction is given by unqualified persons. It is well, therefore, to select the best teachers possible, and to remember that until the qualifications of the teaching staff are high we cannot expect normal results. A *professor of agriculture* in a University should have passed through such a course, for example, as is given in the "*Institut National Agronomique*" of France, or any other of similar completeness [Chaps. XLIV, XLV, pp. 580–645], and should have been an eminent original contributor to agricultural science. This is a point which will be again referred to.

A general instructor or *Director*[2] *of a Secondary School* of Agriculture should have passed through a similarly complete course, and should possess in addition a thoroughly *practical* knowledge of agriculture. His theoretical qualifications would of course be of a lower order than the former.[3]

For the other grades of instructors it is merely necessary that the underlying scientific knowledge, and the practical knowledge of the subject, should, in each instance, be of a distinctly higher grade than that possessed by the pupils to be instructed.

A good system of agricultural education, capable of achieving such results as have been obtained in Continental Europe, cannot be built up from the primary school; it must be dominated by the higher results which are to be found in instruction of the University type. The matter is of such vital importance as to demand careful consideration and some completeness of statement.

The present remarkably fine educational organisation of Prussia had its origin in the attempt of Frederick William III to retrieve the crushing disasters which Napoleon I inflicted upon that country in 1806: *first*, by founding a great University; *secondly*, by developing the higher grade schools; *thirdly*, by organising elementary education. *The order of importance was that just indicated, and not vice versa.* And the great improvement in agriculture in Germany, by which, for example, the yield of beet sugar was raised from 5·72 to 13·00 per cent., came about through the domination of the lower forms of instruction by the influence, the spirit, and traditions derived from the higher forms. The fact that in a democracy it is less easy to repeat this method of Frederick William's is a strong reason why our public men should give the matter their most serious attention.

This principle enunciated is quite general and is the *secret of success.* We shall do well to see that all instructors appointed in this branch, and, indeed, in all branches of technical education, are of sufficiently high calibre for each grade of instruction, and that each has been infected, so to speak, with the instincts and traditions of the superior grade, so that from the highest to the lowest branch of instruction and practice, the scientific method and attitude shall be the dominant ones. The paramount influence of the Continental type of University, with its "*Akademische Freiheit*" (academic freedom) and passion for research, is the secret of the very high character of teaching in Europe, and of the satisfactory moulding of American teaching.[4]

The

[1] Post-graduate courses in English and Colonial Universities.

[2] Principal, or headmaster. Director seems to be a far more appropriate term.

[3] What is needed in this State is that recognition of the *paramount* importance of theoretical training and of high scientific qualification which is *characteristic* in Continental Europe, and is rapidly becoming the governing principle in American education.

[4] The American does not hesitate to appoint professors from Europe. That the best policy is to appoint the ablest men is well recognised in that progressive country. A great many Americans qualify by study in Europe, which is excellent.

The home of the highest form of agricultural education should be an agricultural university, or a *properly constituted* scientific and practical course in a general university. This would provide for a corps of properly educated secondary teachers. The secondary schools of agriculture, besides turning out practical agriculturists, would provide well-trained instructors for lower schools.

The experience of the United States of America and of Continental Europe confirms this view, and the decay of agricultural industry in Great Britain is a warning that British neglect of agricultural education is fraught with serious consequences.

The remarkable agricultural progress of Belgium, Denmark, and Holland, since the adoption of the scientific method of instruction, is proof that the apparently enormous expense of a good system of agricultural education is, after all, the only sound economy. This needs much clearer and more general recognition. One has only to form an estimate of the value of an improved yield to see that the cost of agricultural education is quite eclipsed by the value of the productive increase following as a consequence.[1]

The recognition of the *vital importance* to industry of the highest forms of education, and of the *peremptory necessity* of so organising education that the higher forms shall have a dominating influence over the lower, is universal through the United States of America, and through the important countries of Europe. This recognition is the key to the whole situation : it is unquestionably the condition of industrial success, so far as education can affect the matter ; and the general result of a review of the whole organisation of agricultural education in every country which has achieved conspicuous agricultural success is, that the principles just outlined must be followed also in this State if we too are to command success.

3. *The Various Forms of Agricultural Education.*—Neglecting forestry, which will be dealt with by itself, the forms of agricultural education to be found in various countries are numerous. They may be outlined as follows :—

(1) Instruction in Agricultural[2] Universities or High Schools; in Agronomical Institutes, etc.

(2) Or in Universities with a completely organised scheme of Agricultural Instruction, and with the equipments and other means for affording the necessary practical forms of instruction in addition to the theoretical.

(3) Special advanced Lecture Courses for persons possessing a high scientific training, suitable for proprietors, managers, and farmers of very large estates.

(4) Secondary Agricultural Schools, with well-organised courses of theoretical and practical instruction.

(5) Special lectures for persons qualified to receive instruction of the secondary grade.

(6) Farming Schools, Schools for Dairying, etc.

(7) Agricultural Schools, held for part of year only (*e.g.*, Agricultural Winter Schools, Travelling Schools, etc.).

(8) Lower Agricultural Schools.

(9) General Rural Improvement Schools.

(10) Courses of lectures in Elementary Agriculture (*i.e.*, of lower grade than secondary education in the subject).

(11)

---

[1] For example, there are 1,561,000 acres of wheat, yielding about 27,334,000 bushels, valued at, say, £3,974,840—roughly, say, at 3s. per bushel. An increase of only 10 per cent. would represent no less than £397,000 ; but successful farming would tend to increase the area put under cultivation, hence this amount would not represent anything like the real advantage accruing from better agricultural education.

[2] "Agricultural" may here be understood to include horticulture, etc., and also in the subsequent references.

(11) Instruction in Elementary Agriculture in Primary or Elementary Schools, by means of school gardens, etc.

(12) Scientific instruction (in any schools), so orientated as to disclose the relations of science to agriculture.

Agriculture, as above referred to, must be understood in the extensive sense previously indicated. The above forms exist for most countries of Europe, and are to be found widely distributed through America.

4. *Highest Forms of Agricultural Education—Entrance Conditions.*—The highest forms of agricultural education are to be found in universities and in special agricultural high schools and institutes. In order to give some idea of the very advanced character of the instruction provided, particularly in Europe, time-tables and even detailed programmes have been given. Attention is drawn to the high conditions of entrance—for example, the passing in Germany of the *Abiturium, i.e.*, the leaving examination of the secondary school, a very much more difficult and thorough examination than the matriculation of an English or colonial university—or the passing of such an examination as that required to enter the *Institut National Agronomique*, of France, which includes arithmetic, algebra, geometry, trigonometry, descriptive geometry, mechanics, cosmography, physics, including heat, acoustics, optics, electricity and magnetism, chemistry, zoology, botany, geology, physical and economic geography, and a foreign language. [*See* Chap. XLIV, sec. 2, pp. 580–585.] A reference to Chap. XLIV will disclose the fact that the student entering the institution referred to has had a preliminary education on a sufficiently broad scientific basis to ensure his thoroughly profiting by the course of study undertaken therein. One cannot insist too strongly on the very marked difference in the state of preparation for advanced courses in England and in the English colonies, and the state of preparation in Europe, and it is well to bear in mind also that this high degree of preliminary education required on the continent is supposed to be reached at the age of 20 years.

The breadth and thoroughness of the science teaching is the secret of the excellence of European teaching in technical subjects. The scientific spirit is manifested in the avocations of the people in a way that has not yet characterised our community. The results of scientific research are applied industrially, and they raise the plane of special education. It is necessary to recognise these facts in order to clearly understand the exact nature of the highest type of course in Europe, and its practical effect.

The thorough courses in agriculture which are available for European youths, are set forth in various chapters, enumerated below. Chapters XLIV and XLV [pp. 580–645] give the details of the magnificent courses of the *Institut National Agronomique* of France, in the fundamental sciences underlying agriculture, and in agronomy. The courses are given by very able instructors, some being brilliant contributors to original research, and all having made and published original investigations. This matter will be more fully referred to later.

Although the entrance conditions for higher agriculture are on a much more advanced plane in continental Europe than in the United Kingdom, in America they are much the same as for other University courses there. The "glory of foreign Universities," which, according to Professor Pearson, the scientific men of the United Kingdom are everywhere recognising, is due to this fact of *higher preparation.* In Europe the attainments on entering the University shew greater maturity of mind, and more thorough preliminary training, and the high character of the European courses in agriculture as compared with others is no exception. The results achieved are due to the same fact, *viz.*, that the student on entering a High School of Agriculture in continental Europe, has already been familiarised with the fundamental elements of mathematics and the natural sciences. He is working on a much higher plane than the matriculant of our own State University. There is no short road for the attainment of equal results[1].

5.

[1] Touching the grade of work of European High Schools and Universities, it is very desirable that the defects of our own system should not be sheltered under an affectation that the methods of foreign Universities are inconsistent with our national characteristics. The main thing is to raise the plane of our educational work, else to use the words of Mr. Swan already quoted, we must submit to national decay.

5. *Courses in Higher Agriculture.*—The higher forms of agricultural education are referred to in the following chapters of the report, viz. :—

REFERENCES TO HIGHER AGRICULTURAL EDUCATION.

Chapters.	Sections.	Pages.	Refers to—
XXXII	8	325–6	Courses in Agricultural Science, Technical High School, Munich.
"	13	329	Course for Agricultural Engineers, " " " "
"	18	335	Course in Agriculture, " " " "
XXXIII	4	341	Agricultural and Forestry Division, Zürich Polytechnicum.
XXXVIII	32	451	Course in Agriculture, Sheffield Scientific School, Yale University.
"	44	455	" " " " " " "
XXXIX	12	468–9	Agriculture Course in Yorkshire College, Leeds, Victoria University.
"	13	469–70	Instruction in Agriculture, Durham College of Science, Newcastle-upon-Tyne.
"	20, 21	472–3	Courses in Agriculture, University of Edinburgh.
"	26, 27	476–7	" " " Glasgow.
"	28	478	" " Royal University of Ireland.
"	29	478–9	Agricultural Courses, University College of Wales, Aberystwyth.
"	30	479–80	" " " " North Wales, Bangor.
"	32	481	" " " " South Wales, Cardiff.
XL	1	518	Reference to Agricultural Institutes in Universities of Berlin, Breslau, Giessen, Göttingen, Halle, Jena, Kiel, Königsberg, Leipzig, Technical High School of Munich.
"	2, 3	519–20	Courses of Agricultural High School of Hohenheim, near Stuttgart.
"	7, 8	521–3	" " " " " Berlin.
"	9	524	Course in Agricultural Engineering, Berlin Agricultural High School.
"	10, 11	525–6	Equipment and Original Research, " " " "
"	12	526	Poppelsdorf Agricultural High School.
"	14	528–9	Agricultural Institutes of German Universities.
"	15	529	Agricultural and Brewing School, Weihenstephan. (A secondary school really.)
XLI	6	541–2	High School for Agriculture and Forestry, Wageningen.
"	12–16	546–50	Course of Studies, Institut Agricole of Gembloux, Belgium.
XLII	2, 3	559	Agricultural Instruction in Vienna.
"	4, 5	559–60	" " Cracow, Prague, etc.
"	17–23	563–8	Courses in the Agricultural High School of Copenhagen.
"	27, 28	569–70	Courses in the Superior Agricultural Schools of Italy.
"	30	570–1	Agricultural Institutes of Sweden.
XLIII	2, 4	573–4	Course in School of Agriculture, Polytechnicum, Zürich.
"	5	574–5	Course in Agricultural Engineering, " "
XLIV	2	580–5	Entrance requirements of Institut National Agronomique of France.
"	3–39	585–621	Courses in full, fundamental sciences " " "
XLV	2–25	622–645	" " agronomy " " "
XLVI	2–5	646–8	Courses in Berkeley College of Agriculture, University of California.
"	6–10	648–650	Courses in College of Agriculture, Cornell University.
"	14, 15	652–3	The Bussey School of Agriculture, Harvard University.
"	16	653–4	Courses of Agriculture, Purdue University.
"	18, 19	654–5	" " Wisconsin "
"	24	655	Reference to Agricultural Courses in Arkansas, Georgia, Illinois, Louisiana, Maine, Minnesota, Missouri, Nebraska, Nevada, Ohio, Tennessee, Vermont, West Virginia, and Wyoming Universities.

A study of the various programmes enumerated in the above list will disclose the very advanced character of modern Agricultural education of the highest type. The characteristic feature of the work in the Universities of Europe, is the large quantity of original investigation which is undertaken by the professors and students, and the drift in America is in the same direction. These scientific researches, of the significance of which the raising of the percentage of sugar yield of beet from 5·72 to 13·00 may be taken as a good illustration, are the secret of agricultural success. The scientific manuring of soil, selection of seed, and method of culture, is transforming agricultural industry, and other things being equal, a population ignorant of scientific agriculture has no chance of competing against one that has.

6. *Range of Higher Instruction in Agriculture.*—More than a brief indication of the comprehensiveness of higher instruction in Agriculture in Europe, would be impracticable. Any interested reader must refer to the chapters and sections above enumerated.

In the *Institut National Agronomique* of France, the instruction is divided into three sections, viz. :—

(1) The Study of the fundamental Sciences of Agronomy.

(2) The Study of the subject matter of Agronomy itself.

(3) The Study of Practical Agriculture.

The study of the fundamental sciences embraces the following :—

Natural Science :—The biology of plants cultivated in France and French Colonies; general physiology; zoology applied to agriculture; geology applied to agriculture; vegetable pathology.

Physical and Chemical Science :—Physics and meteorology; applied chemistry, viz., investigation, analysis, etc.; agricultural chemistry; applied organic chemistry.

Mathematical Science :—Mathematics; mechanics and agricultural hydraulics; mathematics and topography; graphic and topographical drawing.

Social Science :—Rural legislation and administrative rights; rural economy; agricultural accountancy; political economy.

The study of Agronomy embraces :—Agriculture; zootechnics; agricultural machinery and rural construction; agricultural technology; economics of forestry; viticulture; colonial cultures; comparative agriculture; arboriculture; pisciculture; hippology.

It is quite impossible to give any satisfactory idea of these courses by brief mention; reference must be made to the body of the Report [Chap. XLIV, secs. 7–39, pp. 587–621; Chap. XLV, secs. 4–24, pp. 622, 645]. The unbiassed reader will recognise on turning to these that, so far, we have nothing comparable to the course in the French national institute. Even if a chair in agriculture were founded at the University and were liberally equipped, the University with this addition, but otherwise as it stands at present, could undoubtedly not furnish such thorough instruction.

For the further illustration of the character higher agricultural teaching, the courses in Königsberg and Munich in Germany, and in Cornell in America may be mentioned.

The Königsberg course is as follows :—

Agriculture.—Agricultural management; valuation of estates; general crops; special crops; meadow cultivation; market produce; scientific basis of plant cultivation; moor cultivation; diseases of field and garden crops; general breeding; special breeding; milk production; butter-making; cheese-making; physiology of domestic animals; external diseases of domestic animals; contagious diseases of domestic animals; horse-breeding, agricultural chemistry (i); feeding, and fodder for domestic animals; agricultural chemistry; (ii) nutrition of plants; noxious insects; agricultural bacteriology; micro-organisms in fermentation industries.

Agricultural engineering, agricultural machinery and tools.—Surveying, levelling, and plan drawing; agricultural machinery and tools; irrigation and drainage.

Natural Science.—Chemistry; physics; mineralogy; geology; and palæontology; zoology; botany; astronomy; selected branches of bacteriology.

State

---

[1] From the point of view of local ideas our University is well equipped; from that of European ideas, it is not so. Its scientific and technical schools need further development. If its recent rate of progress be maintained it may be expected to meet the needs of thorough scientific and technological instruction in the near future, so far as equipment is concerned, but not otherwise.

State Science.—Theoretical and general national economy; financial science; introduction to State science; practical national economy; political economy; commercial politics; history of national economy; public credit; social politics; socialistic theory and socialistic movement in Germany.

Demonstration and practical work.—Experimental laboratory work with reference to breeding and milk production; chemical laboratory; practical bacteriology, agricultural-physiological laboratory; agricultural book-keeping and calculations; demonstrations in the animal clinic; demonstrations in the botanic garden; agricultural excursions; seminary for State science; exercises in political and financial economy.

General Educational Subjects.—Selected law; philosophy; psychology; æsthetics and ethics; mathematics; geography; history; archæology; history of art; literature; modern languages.

In Munich the agricultural courses, proper, cover the following range, viz.:—

Comparative anatomy of domestic animals; embryology and history of the development of the domestic animals; general meteorology and climatology with special regard to agriculture and forestry; science of agriculture and chemistry of soils; agricultural chemistry, viz. (i), the nourishment of plants; (ii) feeding of animals of service agriculturally; (iii) practicum in agricultural chemistry; general agriculture and botany, with demonstrations in the agricultural laboratory; the rearing of plants; cultivation of special plants; ameliorations, with demonstrations; meadow-cultivation, with demonstrations; moor-cultivation; agricultural implements and machines; general theory of animal-breeding and hygiene; special theory of animal-breeding, with demonstrations; breeds, judging, breeding, maintenance, and feeding; ox, sheep, horse, pig; poultry-breeding; pisciculture; agricultural pursuits, viz. (i), husbandry; (ii) the organisation of husbandry; agricultural calculations; theory of agricultural taxation; agricultural technology, viz. (i), fermentation industry; manufacture of sugar and starch; (ii) dairying with demonstrations on the State farms at Weihenstephan; agricultural architecture; diseases of agricultural plants; theory of diseases peculiar to animals; practice in zootomy and horse-shoeing; agricultural experimental stations; exercises in the valuation of soils; demonstrations on the experimental fields and on the State farms at Weihenstephan for this purpose; scientific studies in the agricultural laboratory and on the experimental field in summer.

The instruction in agriculture at Cornell University, Ithaca, embraces:—

(1.) *General Agriculture,* which includes the study of wheat culture; the inspection of roads, bridges and farm buildings; hippology; including breeding, judging and scoring horses and sheep; special investigations and seminary work for advanced students; history and economics of agriculture; German agricultural reading; farm buildings; special studies for students of veterinary science; and winter courses in general agriculture.

(2.) *Animal Industry and Dairy Husbandry,* dealing with the principles of breeding, history and development, improvement and creation of dairy and beef breeds of cattle, etc.; also the making of butter and cheese; and the treatment of milk. Dairy-building is taught; poultry-breeding, feeding and management; construction of buildings, incubators, etc. There are winter courses in the subjects also.

(3.) *Horticulture*—Evolution of cultivated plants; greenhouse construction and management; the literature of horticulture and landscape gardening; pomology; nursery and orchard practice; principles of vegetable gardening; German or French horticultural reading; handicraft and investigations. There is also a winter course in fruit-growing.

(4.)

(4.) *Winter Course in Agriculture*, in which consideration is given to agriculture, animal industry, dairy husbandry, horticulture, and to agricultural chemistry, economic entomology, applied botany, poultry-keeping, and diseases of farm animals.

(5.) *The Agricultural Experiment Station*, for conducting experiments in animal and plant growth and reproduction, and in applied, comparative and scientific research and investigation, is a department of the College.

The organisation of the agricultural courses in American Universities[1] has not yet reached the plane of the instruction in the continent of Europe.

7. *Normal Qualification of a University Professor of Agriculture.*—Agricultural education is of such vital importance to our State, that the creation of a *chair in agriculture* in the University is a question which must engage public attention in the near future. The agricultural industry is decaying in England, and the plane of instruction there is not equal to that of Europe: hence when the appointment of a professor to a chair of agriculture comes up for consideration, the only qualification which should be recognised as satisfactory is that the candidate, besides possessing general qualifications, has passed through the complete course of one of the most distinguished European schools of agriculture.

It is desirable that the Government should despatch a brilliant student, possessing the requisite general and linguistic qualifications, to study agriculture in Europe, so that he may favourably influence the future agricultural education of the State.

Touching the normal qualifications of a professor for a chair in agriculture, who, in virtue of his position, should have practical knowledge of the highest planes of agricultural education, it may be mentioned that throughout the higher educational institutions of America and of Europe, it is recognised that in order to advance knowledge, it is requisite that all higher appointments should fall to men who have themselves made important contributions of new material to the world's repository of knowledge. To be qualified for such appointments applicants must unequivocally have proved their capacity for investigation, for research, for the discovery of scientific truth; mere erudition, the capacity to commit to memory the achievements of others, and so-called "practical" knowledge—which is really the same thing—are recognised as *insufficient*. The distinguished advances that have been made in agriculture have *not* been made by so-called "practical" farmers, but by scientific experimentalists. It is the work of such men as Justus von Liebig and Professor Berthelot, for example, that the world owes so much for the conspicuous advancement in agriculture, and to whom it is so deeply indebted for increased agricultural wealth. Reference is made hereinafter to some of the great contributors to modern agriculture, at present it is sufficient to observe that good agricultural education, and the production of wealth through agriculture, will depend very largely upon the personality, experience, and genius for research of the person appointed to the chair of agriculture. If this appointment be rightly made, the influence of the personality of the professor will do much to place and keep agricultural education, as a whole, on right lines, by creating a highly efficient staff of instructors available for agricultural teaching, and by giving currency to sound traditions respecting higher and lower forms of agricultural education.

8. *The Secret of Recent Agricultural Progress.*—The history of agriculture confirms in a remarkable way the proposition that the most abstract forms of scientific research are of great practical value and importance.

The researches of René Réaumur [1683–1757] in France, of J. G. Wallerius [1709–1785] and his successor Torbern Bergmann [1735–1784] at Upsala, in Sweden, of our own countryman Henry Home, [Lord Kames, 1696–1782] disclosed the fact that chemistry and the systematic study of plant-life had great significance for agriculture. Antoine Lavoisier [1743–1794] was probably the first to devote *systematic* attention to agricultural chemistry, viz., in 1789. The chemical theories of Joseph Priestley [1733–1804] helped forward the recognition of its

[1730–1799],

[1] One is impressed with the greater practicality and directness of the courses of an American University.

practical importance. The experiments on plants made in 1779 by Jan Ingenhausz [1730–1799], the researches in Switzerland of Jean Senebier [1742–1809] on vegetable physiology, those of Nicolas de Saussure [1709–1790], of his son Horace [1740–1799], and of his grandson Nicolas Théodore de Saussure [1767–1845] in the chemistry of plant-life, published in 1804, all shewed to what an extent agriculture could be made dependent upon chemical and physiological science.

Chairs in agricultural economy were founded in Upsala and Lund, in Sweden, in 1740, 1750, and 1759, Karl von Linné [Linnæus, 1707–1778] wrote much on agriculture and on the native plants which might be employed in the manufacture of bread and food in the absence of the cereals; Anders J. Retzius [1742–1821] drew up a *Flora Œconomica*; J. J. Berzelius [1779–1848] gave lectures on "Animal Chemistry" in 1806–7–8; Wallerius, before referred to, wrote on the "Chemical Foundations of Agriculture," and on the "Theory of Soils."

These facts disclose the great scientific and practical interest in agriculture characteristic of continental Europe, and reveal the calibre of the men to whom agriculture is really indebted.

One of the first *schools for the scientific study of agriculture* was Thaer's, established at his farm at Celle, about 26 miles north of Hanover, in the year 1802, and removed to Möglin in 1804. The great reputation which Thaer's school quickly acquired caused others soon to be opened. That at Hohenheim, seven miles from Stuttgart, was created in 1818; it is an Agricultural High School to-day. Schools at Idstein and Schliessheim were also opened in the last-mentioned year. Mathieu de Dombasle founded the school at Roville, near Nancy, in 1822; that at Jena was opened in 1826. In 1829 the school of Grignon, in France, was founded, and also one at Tharandt, in Germany, and in the year following Rieffel established the school of Grand-Jouan, also in France. In Sweden, Edvard Nonnen [1804–1862], a pupil of Thaer's, established the first agricultural college at Degeberg in 1833, but the Academy of Agriculture (*Landsbruksakademi*) was founded twenty-two years before this, viz., in 1811.

As is well known it is the work of Justus von Liebig [1803–1873] which placed the theory of plant and animal production on a thoroughly scientific basis; his work, and that of Boussingault, Lawes, Gilbert, Weckerlin, Wolff, and others were of course epoch-making.

If the academic history of continental Europe be compared with that of the United Kingdom in any broad and comprehensive way, it will be seen that however brilliant may have been the contributions of British genius, there is a degree of appreciation of pure and applied science in Europe which is lacking in us. And this is conspicuously seen in the failure to find a place for agricultural and some other forms of applied science in the British University until quite recently. In Europe, on the other hand, literary contempt on the part of universities did not play so effective a part in preventing science occupying an honourable place in the general esteem. The secret of the success of agriculture in Europe is, however, not dependent merely upon the fact that continental universities and continental technical high schools have found a place for systematic instruction in regard to that subject, but rather upon the fact that the popular instinct in Europe responds favourably to scientific achievement of every kind.

The work of Berthelot has revealed how much the agriculture of the future may depend, not only upon chemistry, but upon physics, bacteriology, and other branches of science, at first apparently but remotely connected with it. The discovery of the function of the nitrogen-fixing organisms, and of micro-organisms generally, of the influence of electric and other radiations upon growing plants, of the importance of seed selection, and the possibility of modifying plant-life by selection and hybridisation, etc., has at least shewn that the hope of successful competition with the agriculture of other lands depends very largely upon our possessing the secret of modern agricultural success, viz., alertness in availing ourselves of the results of modern scientific research. *This alertness depends absolutely upon that perfect sympathy with the advance of science, which comes with participation in the scientific work of the world*, and is not given to a community that merely hopes to exploit the advance made elsewhere without contributing its own quota to progress.

The brief history above given of the progress of agricultural education shews that the scientific truth fell in Europe upon prepared ground, so to speak.

9.

9. *Effect of the Absence of Higher Agricultural Education.*—If agricultural education in this State is to be excellent, the influence of its highest form must tincture the whole. That, as has been shewn, is the way of assured success.

The failure to establish, so far, a chair in agriculture in the University of Sydney is no doubt in part due to the absence of recognition, in the English monastic type of University, of the fundamental importance, and real scientific value of agricultural education, and to the fact that the main outlines of the organisation of our University and its general traditions, are governed largely by the traditions of the universities of the United Kingdom, where agriculture did not find any appreciation till quite recently. Financial limitations are also a sufficient reason for the non-establishment of such a chair, though for a considerable time it has been under consideration.

When the chair is established, however, it is important that the responsible authorities should see that it is representative of the highest forms of agricultural education, and that it commands experience of the proper kind. The effect of the absence in our university of a good system of agricultural education has very far-reaching effects, which it behoves us to take into careful consideration.

Remembering that the problem before us is to infect a part of the community with a recognition of the fact that agriculture, properly undertaken, gives very different results to what may be expected from a haphazard, methodless, unscientific agriculture, we see that at least a staff of well-trained secondary teachers of the subject is essential for the spreading of a true view, and of the requisite information.

In this State we are in a more than ordinarily difficult position, owing to the practical absence, up to the present time, of nature-study and science-teaching in our elementary schools.[1] For this a corrective must be found. The spirit of the continental and the *modern* British University must tincture our whole life before every class of teacher is properly qualified.

Looking through the contributions to agricultural knowledge referred to in its early development, to the work of Liebig and his contemporaries, and to recent achievements in the province of agriculture, it is obvious that agricultural success is dependent upon that *popular and wide-spread appreciation and respect for science* and scientific achievement which will cause the ordinary agriculturist to instinctively apply the scientific method in agriculture, and to instinctively turn to scientific knowledge for assistance. This spirit does not exist in a general way in our community because, in our scheme of public instruction, the elementary school has been practically scienceless, at least in comparison with the elementary schools of Europe.

The University has large opportunities of favourably influencing both directly and indirectly every class of teacher, and in each branch of science it can help towards the general result by responding more fully to the modern needs of mankind. The teaching of pure and applied science, and of the modern languages which are the repository of so much that is of practical value as well as of so much that is liberalising and cultural,[2] need greatly strengthening, as will be evident from the next section of this division.

The absence at the present time of the highest grade of agricultural teaching limits to some extent the opportunity of making the efficiency of our secondary schools of agriculture what ideally it ought to be; it may also be mentioned *en passant* that the absence of a thorough scheme of preparatory education for the students who enter these secondary schools also limits them though in another way.

10.

---

[1] The reform now taking place aims at correcting this. It has to be remembered that efficient teaching in natural history and natural philosophy cannot be brought about by a stroke of the pen. Before teachers as a whole are efficient, there is a long hill to climb, and until a thorough scheme of professionally training teachers is established, we shall have to be content with very limited ideas of efficiency, and in the meantime make special efforts to correct the crudities to which the pupil-teacher system has exposed our education.

[2] At present the University of Sydney not only makes Latin compulsory in matriculation for courses in every subject, it also assigns to it a preponderating value in deciding whether a candidate has passed or otherwise. Nearly all the Universities of the world, including those of Great Britain, have quite abandoned this attitude. If the University of Sydney is to fulfil its normal mission to the people of the State, it will be necessary to fall into line with progress achieved in other parts of the world, in respect of the abandonment of Latin as compulsory for all courses, and also to allow greater weight to modern languages and to science. It will be also necessary to allow freer options as to courses of study, as in Europe and America.

10. *The High Efficiency of European Agricultural Schools.* — The great efficiency of European agricultural schools of the first order is due to the high qualification and great breadth of attainment represented in the numerous teaching staff; to the fine equipment in the way of laboratory and other material; to the thorough organisation of the curriculum; and to the spirit of the Continental University as regards student freedom and as regards research.[1]

A glance at the list shewing the staff of the Zürich Polytechnicum [Chap. XXXIII., sec. 12, pp. 348-354] will reveal the great teaching power of the institution. Many of the staff are contributors of eminence to original research.

Similarly a reference to the staff of, say, the National Agronomical Institute of France [Chap. XLIV., secs. 4-5, pp. 586-7] will disclose the same teaching efficiency. Up to 1901 the professor of the biology of plants had published about 290 original contributions to science, the professor of physics and meteorology over 150, and similarly with regard to many others. This is the class of teacher who is selected in Europe.

It is imperative on the continent that public teachers of the higher class shall be systematic investigators and genuine contributors to knowledge, and that explains their *power*.

At the Technical High School of Munich, the teaching staff of the *Agricultural Division* consists of two professors of agriculture; one professor of agricultural chemistry, one "extraordinary" professor of agriculture; one honorary professor for special botany; one professor of agricultural chemistry specially relating to the theory of nutrition applied to animals and to dairying; in all five. Besides this there are five assistants, and of course a very large staff for the other subjects taken by the students of agriculture and agricultural engineering. [*See* Chap. XXXII., sec. 2, pp. 318-9].

The Agricultural High School of Berlin, in 1902, had the following staff [Chap. XL., sec. 7, p. 522] viz.:—

> 7 professors of agriculture, forestry, horticulture, natural science; 2 of physics and meteorology; 5 of chemistry and technology; 1 of mineralogy, geology, geognosy; 5 of botany, vegetable physiology; 4 of zoology, animal physiology; 3 of veterinary science, 1 of law and state science; 2 of agricultural engineering; 3 of mathematics and geodesy; 7 of a miscellaneous character; totalling 40, which with 25 assistants makes a grand total of 65.

This heavy staffing is part of the secret of the *vigour* of the Continental University and of the Continental Technical High School, and enables one to recognise why Dr. Peter's affirms that English expenditure on technical education is "ridiculously small" compared with that of Germany.

A single illustration of the laboratory and material equipment of the same school will suffice to make apparent the practical character of the continental belief that good education is economically sound, and that it is worth paying for by the State. The equipment of the Berlin Agricultural High School is as follows [Chap. XL., sec. 10, p. 525], viz.: —

> A cabinet for physics; a chemical laboratory; the mineralogy and geology department of the museum; the agronomical establishment, and the agronomy department of the museum; the botanical institute; a plant collection; a zoological institute and the zoological department of the museum; the physiological institute; the zootechnical institute and department of the museum; a collection of machinery; a seminarium for State science; a seminarium for agriculture (plant culture); a seminarium for zootechnics (animal breeding); an institute for agricultural experiment, bacteriology, etc.; a seminarium for agricultural engineering; a seminarium for building technique; a geodetical cabinet; a seminarium for mathematics; an institute for the fermentation industries; an institute for the beet sugar industry; the experimental station of the German Flour-mills Association; an experimental granary; a library; a museum.

It is impossible to fail to perceive the great liberality of such equipment.

11.

[1] Under the Continental University system, reputation depends more upon what a student *does*, than upon what he *remembers*. Original contributions of merit are the only "open sesame" for academic positions, and the University life is instinct with appreciation of the power of investigation, and of the genius of research, to which are due the extension of human knowledge.

11. *Conclusion regarding Higher Agricultural Education.*—If agricultural instruction in this State is to compare in efficiency with that in Europe, it can do so only by the same liberality of equipment in personnel and material. Will this pay? The decay of agriculture in Great Britain, the hopeful signs of its improvement in Ireland since the introduction of agricultural instruction, the splendid progress in Europe, the success of the continental attack on the problem of sugar production—with its disastrous effect upon the production of cane-sugar—all go to shew that the best agricultural education "pays." The value of such researches as Mr. Farrer's, in this State, for the production of a rust-resisting wheat, is difficult to estimate exactly, but it is easy to see that such researches may make all the difference between hopeless failure and complete success. Have we reason to believe that the necessary expenditure on higher agricultural education will be more than repaid by increased production? If we have, then it ought certainly to be instituted as the only thing warranted by a sound State economy. The continental belief is, as I have said, that higher education *pays*, and thus the money for its development is provided.

At present we have not practically recognised that good education is the only sound economy, for the popular impression appears to be that the financial support and subsidy of our highest institution is ample. But compared with Europe, and making every allowance for great differences of population, we have not yet put forth the same effort to make our people first-rate agriculturists, and *one* of the important steps will be to provide the highest type of agricultural instruction, viz., that to be found organised in continental Europe.

We have, as has each country, our own agricultural problems to solve, the conditions being in many instances special to the country. Success will be assured not by merely following the lead of other lands, but by making our population *capable*, in an agricultural sense, by supplying the opportunity for good agricultural education. This will give that initiative and resource which has gone so far to command success elsewhere, and which has proved that the application of the scientific method pays in agriculture.

VIII.

VIII.

SECONDARY AGRICULTURAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—Secondary agricultural schools will always, and in every country which needs agricultural education, be of conspicuous importance, for the greater number of agriculturists on a large scale must get their training in them. For such schools to fulfil their functions properly, the necessary preliminary education should be assured through the elementary schools, etc., and the student ought to enter with at least elementary knowledge of the physical sciences, mathematics, botany, and zoology. Schools of the type of the Hawkesbury Agricultural College are most important, and will achieve in the future far greater results than at present, since, when a proper preliminary education has been received by all students, the organisation of the instruction can be greatly advanced, and the whole plane of work will be raised and made more thorough.

The secondary grade of agricultural education takes many forms, and is variously organised in different countries. It leans towards general agriculture on the one side, or to dairying on the other, and great specialism of treatment of particular elements may be noticed. The reference hereunder to various forms treated in the body of the report will disclose this.

2. *Secondary Agricultural Courses.*—To understand the extent and variety of secondary agricultural instruction provided for young people in various countries, reference should be made to the following passages of the report hereinafter.

REFERENCES TO SECONDARY AGRICULTURAL EDUCATION.

Chapter.	Sections.	Pages.	References.
XX	36–45	232–235	Courses in Agriculture in the Tuskegee Institute, Alabama.
XXXIX	29	478–479	Diploma Course in University College of Wales, Aberystwyth.
,,	30	479–480	,, ,, ,, ,, ,, Bangor.
XL	15	529–530	Courses in Agricultural and Brewing Schools of Bavaria.
,,	17–19	530–531	Courses, Staff and Equipment of Secondary Agricultural Schools in Germany
XLI	2–5	538–540	Courses at the College of Wageningen, etc.
,,	12–14	546–548	The Institut Agricole of Gembloux.
,,	18	550–551	Highest Grade of Secondary Agricultural Education, Belgium.
,,	19	551	Various Secondary Agricultural Schools in Belgium.
,,	21	552–554	Agricultural Sections of Belgian Secondary Schools.
XLII	6–7	560	Secondary Agricultural Education in Austria, Bohemia, etc.
,,	26–28	569–570	Agricultural Education in various parts of Italy.
,,	30–31	570	Secondary Agricultural Education in Sweden.
XLIII	7–10	575–578	Courses and Equipment of the Institut Agricole, Lausanne.
XLVI	3	647	Limited or Special Courses, California University, Berkeley.
XLIX	......	687–710	Secondary Agricultural Education in New South Wales.

The above list will give a sufficient idea of this variety and extent as it is exhibited in Europe, and will give also some notion of its organisation in America.

3. *Agricultural Education at Tuskegee, Alabama.*—The Tuskegee Institute at Alabama, a school for the training of negroes, and one of the most remarkable educational efforts in the world, has a "Department of Agriculture," with courses for young men and young women. These are of two years duration, and are as follow:—

Young Men.—English, live stock, market gardening, horticulture, economic entomology, practical agriculture, botany, dairying, bacteriology, vegetable physiology, agricultural chemistry, heredity, seeds and grasses, applied botany, botany and bacteriology, drainage, bacteriology of milk, vegetable pathology, animal nutrition, etc. [Chap. XX, sec. 38, pp. 233–4.]

Young

Young Women.—Dairying, poultry-raising, horticulture, floriculture, landscape gardening, market gardening, live stock, botany, entomology, applied physics, chemistry, agricultural chemistry, etc. [Chap. XX, sec. 37, pp. 232–3.]

Besides having well-fitted laboratories for chemical, laboratory practice, and for other investigation, the Tuskegee Institute is also well equipped for the other features of agricultural instruction, possessing as it does two fine farms, viz., of 800 and 700 acres respectively, and all necessary implements, machinery, and apparatus for scientific farming and general agriculture. It has excellent facilities for instruction in elementary agricultural engineering.

4. *German Secondary Schools with Agricultural Instruction.*—A very fine type of secondary agricultural school has been organised in Germany for the education of estate owners and managers, farmers, etc. The masters in agricultural science of such schools must have passed the *Abiturienten-examen* of a Gymnasium, Realgymnasium, or Oberrealschule; have completed a three-year course in agriculture at the agricultural institute of a university, or an equivalent agricultural high school; have been practically engaged in agriculture for not less than two years; and have passed satisfactorily through a probationary period of one year as master of agricultural science at an agricultural school. The examination passed must be satisfactory in each of the three divisions, viz., (i) Agricultural management; (ii) plant-culture; (iii) animal breeding, and covers the whole field of agricultural science, physics, chemistry, botany, plant physiology, zoology, animal physiology, mineralogy and geology, elements of national economy, and agricultural law.[1] The other masters must have qualified, as explained in the report on Secondary Education. [Chaps. XXI, XXII, pp. 265-279.]

Each school is equipped with the following, viz.:—A physical laboratory, a chemical laboratory specially fitted for the applications of chemistry to agriculture, the necessary experimental buildings, a botanical garden of some magnitude, an orchard, several acres of experimental plots.

These secondary schools have a six-year course, following on three years in a preparatory school; hence they are entered at about 10 or 11 years of age and left at about 16 or 17, the course qualifying for the "*Einjährige Examen*," by the passing of which the military service is reduced from three years' to one year.

The school has two divisions each of three years' duration. In the former the education is general; in the latter it is both general and special. The programme is as follows:—

PROGRAMME OF A GERMAN SECONDARY SCHOOL OF AGRICULTURAL INSTRUCTION.

Subjects.	Classes and Hours per Week.					
	Lower Division—General Education only.			*Higher Division*—General and also Agricultural Education.		
	I.	II.	III.	IV	V.	VI.
Religion	3	3	3	2	2	1
German (mother tongue)	4	6	5	5	4	4
Latin language	8	......	......	......	......	......
French language and literature	......	6	6	6	5	4
History	1	1	2	2	2	2
Geography	2	2	2	2	2	1
Arithmetic and mathematics generally ...	5	5	6	6	5	4
Elementary natural science	2	2	2	4	3	2
Physics	......	......	......	2	2	1
Chemistry	......	......	......	2	3	5
Agricultural production and products... ...	......	......	......	......	3	4
,, management and political economy	......	......	......	......	......	3
Book-keeping and accountancy	......	......	......	......	1	1
Surveying and plan-drawing	......	......	......	......	......	2
Drawing, freehand, etc.	2	2	2	2	2	......
Gymnastics	2	2	2	2	2	2
Singing	2	2	1	2[2]	2[2]	2[1]
Shorthand	......	......	......	2[2]	2[2]	2[1]

[1] It may be mentioned that the practice, not wholly unknown in New South Wales, of proposing to improve the conditions of education by holding examinations, instead of by creating special schools, and equipping them with excellent teachers, is held in derision by continental educationists, and, it is submitted, justly so.

[2] Optional.

Remembering

Remembering the excellence of the teaching equipments, and also the calibre of the teachers, the great practical value of these schools becomes obvious. The instructors throughout are very highly qualified, both theoretically and practically. In all cases they have had the necessary scientific training, and they have at their disposal the necessary equipment for teaching. For fuller information, reference should be made to the body of the report. [Chap. XL, secs. 17–19, pp. 530, 531.]

Attention is drawn to the fact that the *economics* of the subject is well handled, and students learn how to apply it to inquiry as to the prospects of special forms of agriculture.

5. *Belgian Higher-grade of Secondary Agricultural Education.* — In Belgium there are three grades of secondary agricultural education—one of three years' duration, the other two each of two years' duration. The declared object of each of these three is to give "sound professional instruction to the sons of farmers and small proprietors, with a view to creating in them a love for the calling of their parents, so as to *contribute to the development of the national prosperity.*" The instruction has, therefore, an immediate practical end; consequently the professor aims at giving his pupils such ideas as are susceptible of the most direct application. He accentuates the practical application of the scientific principles which he teaches.

The programme hereunder will give a fairly definite idea of the status of the teaching :—

BELGIAN SECONDARY AGRICULTURAL EDUCATION, HIGHEST GRADE.

1*st Year.*—*General natural science*—*Chemical properties of bodies.*—Nomenclature; study of simple bodies and of inorganic combinations which have agricultural interest; laboratory exercises, the setting up of apparatus, etc.; preparations.

Physics, mechanics, and meteorology.—General properties of material bodies; motion, forces, levers, etc.; weight and density; hydrostatics, pneumatics; applications, and manipulations of instruments, and general laboratory practice.

Agricultural zoology.—Classification, and succinct description of the higher and lower animals, useful or noxious from the point of view of agriculture; practical exercises in descriptive zoology; entomologic excursions.

Botany and microscopy.—Organography; anatomy; physiology; practical exercises.

Natural science applied to the cultivation of plant life — Agrology; Agronomy.—Origin of arable lands, properties of soils, amelioration, improvement, drainage, irrigation; practical exercises; excursions.

Natural science applied to the rearing of animals.—Anatomy and physiology of the domestic animals; skeleton, muscles, nerves; respiratory apparatus, apparatus for the circulation, for nutrition, etc.

2*nd Year.*—*Organic chemistry.*—Analysis by the dry method; qualitative analysis by the wet method; laboratory practice.

Physics and meteorology.—Mechanical theory of heat; electricity; agricultural meteorology; manipulation of instruments, meteorological observations.

Special botany.—Study of vegetable families, important from the point of view of agriculture; diseases of plants; exercises; herborisations.

Mineralogy and geology.—Study of mineral substances having relation to agriculture; beds of nitrates, potash salts, phosphates; geological map of Belgium and its uses.

Agronomy.—Agricultural instruments, and work; sowing; tending crops; harvesting; conservation of the harvest; ensilage; rural constructions.

Agricultural chemistry and physiology.—Composition of the plant; rôle of the leaves, of the roots; development of plants; laws of restoration, and of fertilising the soil; experiments; excursions.

Physiology

Physiology of domestic animals.—Origin of animal heat, and of mechanical work; movements, places, direction.

Zootechnics.—Description of the principal races of domestic animals; crossing, inbreeding, appearance, quality, age, description; hygiene, housing, feeding, watering, and drinking, etc.; condiments; farriery, work, harness, etc.; exercises and excursions.

Rural economy, Factors in production.—Land, capital, work; agricultural crises, causes of same; agricultural speculation, combination and co-operation; cultivation on a large and small scale; exchanges, contracts, etc.; problems of rural economy; excursions.

Commerce and legislation.—Contracts of sale and lease: commercial transactions; law in regard to the adulteration of chemical fertilisers; rural law (code rural).

3rd *Year.*—*Chemistry.*—Qualitative analysis of the principal agricultural substances; laboratory work.

Agronomic excursions.

Agricultural chemistry and physiology in continuation of the course of the second year.—Selection; the special physiology of the different agricultural plants; laws of the rotation of crops and experimental researches on vegetation; excursions.

Special cultivations.—Particular care for each cultivated plant; period of sowing, etc.; varieties; diseases and remedies; arboricultural principles in relation to fruit-tree growing and forestry; orchards; exercises and excursions; kitchen-gardening.

Rational feeding of domestic animals.—General principles, special feeding of each species; practical exercises upon the composition of the feed.

Dairy.—Special feeding of milch cows; rational treatment of the milk; manufacture of butter and cheese.

Agriculture and pisciculture.

Agricultural accountancy.—Book-keeping in single and double entry as applied to agriculture; exercises.

Agricultural industries.—Milling, distillery, brewery, sugar-refinery, starch-manufactory, fecula, etc.; chemical fertilizers; excursions to these.

The programmes of the second and lowest grades are of a very similar type, but are, of course, much simpler, in view of the fact that, in order to cover the course in two years, the work has to be restricted.

These programmes will give a sufficient suggestion of the course, the thoroughness of which is assured by (1) excellence of equipments, (2) sound professional education and training of the teaching staff.

6. *Limitations of Secondary Agricultural Education in New South Wales.*—The general traditions regarding primary education which officially obtained till quite recently in this State, are largely responsible for the fact that students entering upon the courses of the Agricultural Colleges, are by no means uniform in respect of possessing sufficient preliminary qualification. The age of entrance is 16, and the only essential qualification is that students must possess "a fair competency in reading, writing, and arithmetic." It may also be noted that arithmetic is one of the subjects of instruction during the stay in the college.[1]

Owing to the admirable organisation of education on the continent of Europe, the state of preparation on entry into secondary agricultural colleges is more uniform and much higher. The improvement of the primary system here will give such schools as the Hawkesbury College a far better opportunity of shewing what they can do for agricultural education. At present the work is embarrassed with difficulties which should not exist. The quality of the instruction can easily advance very considerably as soon as all pupils who enter do so with a good general education, in which the mathematics and science reach a higher grade.

Elementary

[1] That youths 16 years of age need instruction in arithmetic is a sidelight upon the character of our late system of primary education.

Elementary physics, chemistry, botany, zoology, simple algebra, plane and solid geometry, and very elementary trigonometry, ought to be mastered before the student presents himself at a secondary school of agriculture, and certainly would be mastered by youths of 16 years of age in all countries where the organisation of education is at all satisfactory.

A second limitation is the absence of a high degree of specialism in the instruction. The disadvantage of teaching too many subjects is, first, that the teacher's reading of each has to be limited instead of complete; secondly, the teaching of each is not so thorough; thirdly, that no time remains for the teacher to undertake original research and scientific work, properly so-called.

The superiority of the continental schools depends upon the importance attached by them to thoroughness in theoretical work, and to original research, as well as to thorough practical training.

Nevertheless, schools of the type of the Hawkesbury College, with its fine experimental farm, is doing work of incalculable importance for the State, and such schools should be multiplied if we are to meet the normal demand for agricultural education. The organisation of the Hawkesbury College is excellent.

7. *Path of Advance in Secondary Agricultural Education.*—The erection and equipment of a number of schools of the type of the Hawkesbury Agricultural College is of great importance for the future of agriculture to the State. To quote the official view of the Belgian authorities, it is to such schools that we must look for the development of an increased liking for agricultural pursuits, for sound professional instruction in agriculture, and for a considerable advance in national prosperity.

The experimental farms associated with the colleges are excellent, and demonstrate what good agriculture can do. Agricultural accountancy and economics, taught so as to disclose how far any experiment promises to be a financial as well as a scientific success, will help students to decide as their chances with particular crops.

It has been alleged by some critics that the scheme of instruction at the agricultural colleges, fails to guide a student who has afterwards to work under the limitations of a farmer without large capital; that the course of instruction is excellent if the farmer can duplicate all the appliances of the college itself; but that if he has to work without them, he is found to be lacking in initiative, and lacking in reliance upon his power of attacking the problems of agriculture as they actually present themselves. There is undoubtedly some truth in the criticism, but with a proper system of primary education, and the better entrance qualifications which will result, all this will change. Good education insists on the education of *faculty* rather than of *memory;* it trains the pupil to *think* rather than to *burden his mind* with myriads of facts; and when the primary school has been reformed, much now defective in technical and other advanced forms of education will have disappeared.

The most important conditions of progress are (1) insistence on higher entrance qualification; (2) greater specialism, and consequently greater efficiency in the teaching staff; and (3) an anticipation of, and the adjustment of working conditions, so as to admit of the members of the teaching staff undertaking special lines of scientific research. This would not only greatly and directly increase their efficiency, but would also beget that attitude toward scientific progress, without which it is useless to hope for steady and permanent advance.

We can hardly go too far in meeting the wants of all would-be students of agriculture, for they will do much to build up the prosperity of the State.

IX.

OTHER SECONDARY AND HIGHER ELEMENTARY FORMS OF AGRICULTURAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—In addition to complete the scheme of instruction in higher and secondary agricultural schools, it is necessary, in a thorough system of agricultural education, to develope special courses of several kinds, so as to meet the whole of the wants of an agricultural community. Such special courses may be comparable in range to the longer ones, but differ in that they are of a more elementary character; or, on the other hand, they may be equally advanced, but more restricted in range.

In a country in which agricultural education has existed only for a short time, it is particularly desirable, as the experience of such countries as Belgium, Denmark, France, Germany, Holland, Switzerland, etc., fully shews, to organise both short courses and special courses, for the express purpose of reinforcing the skill and knowledge of those already engaged in various agricultural pursuits.

Not only are special and short courses necessary, but so also are lectures on the recent advance of practical agriculture or of agricultural science. These should be demonstrated scientifically, or illustrated by lantern slides, etc., wherever practicable; and may be made of great value to practical agriculturists. Much the same end may be reached by the spread of agricultural information by special publications. The Department of Mines and Agriculture[1] and the Press have done much valuable work in this direction, especially recently.

Illustrations of the range of such secondary forms of agricultural education will now be referred to.

2. *Short Agricultural Courses, and Special Courses in various branches of Agricultural Knowledge.*—The variety in the subject-matter and the organisation of short courses in agriculture, and special courses in branches of agriculture, is considerable. The range of the study by the Commissioner is partly indicated in the table hereunder, which will also, as before, serve for detailed references. It may be mentioned that the subject, however, was studied outside the indicated range, but it was quite impossible in a document of moderate size to give anything like a complete account of the systems of agricultural education of the world.

SPECIAL COURSES IN SECONDARY AND ELEMENTARY AGRICULTURAL EDUCATION.

Chapters.	Sections.	Pages.	Refers to.
VI	35	53	Evening School for Gardeners, Berlin.
XX	39	234	Two-year Course in Dairying, Tuskegee Institute, Alabama.
,,	40	,,	,, ,, Market Gardening, Tuskegee Institute, Alabama.
,,	41	,,	,, ,, Practical Agriculture, Tuskegee Institute, Alabama.
,,	42	,,	,, ,, Stock-raising, Tuskegee Institute, Alabama.
,,	43, 44	234–235	,, ,, Horticulture and Apiculture, Tuskegee Institute, Alabama.
XL	4	521	Farming, Gardening, Schools at Hohenheim, in Germany, and Testing of Agricultural Machinery.
,,	6	521	The Farming and Breeding Establishments of Hohenheim, Germany.
,,	16	530	Special Agricultural Courses in various parts of Germany.
,,	22	532	Farming Schools in Germany.[2]
,,	23	533	Agricultural Winter Schools in Germany.[2]
,,	24	533	Special Agricultural Schools in Germany.[2]

[1] The *Agricultural Gazette* published by the Department of Mines and Agriculture, has been of great and increasing value. Such a journal if produced, as it has been, by the co-operation of the highest scientific experts, working *con amore*, and under competent scientific editorship, will be a factor of unqualified importance in the agricultural future of the State. It is held in high esteem already.

[2] Though entered under the heading of *elementary* agricultural education, the *grade* of work is much the same as in the agricultural colleges of this State.

SPECIAL COURSES IN SECONDARY AND ELEMENTARY AGRICULTURAL EDUCATION—*continued.*

Without reference to the chapters in the body of the report, the above list may not at once make apparent the similiarity or diversity of the organisation of secondary and elementary agricultural education in the various countries referred to. It may therefore be stated that each country is endeavouring to meet the needs of every class of agriculturist, the educational influence proceeding from the Universities downwards.

3. *The Courses of Belgium.*—The provision made for a variety of courses under the Belgian scheme of agricultural education is worthy of considerable attention. Belgium had in 1901 about 6,000 hand separators, and about 400 large co-operative dairies, treating milk supplied by about 25,000 farmers. In 1890 the country imported no less than 6,000,000 kilograms of butter, roughly 13,200,000 lb. In nine years the improvement in agriculture, dairying, etc., had reduced this import to one million kilograms. About a half-million analyses connected with agriculture have been made since 1872 in the State analytical laboratories. This will give some idea of the agricultural activity of the country.

The tone and intelligence of the whole scheme of the agricultural education in Belgium depends very largely on the influence of the *Institut Agricole* of Gembloux. [*See* Chapter XLI, Section 12, pp. 546–7, for an account and a view of the institution.] Besides the forms of instruction already mentioned, there are *courses in agronomy for adults*, which are credited with having done much to raise the character of Belgian agriculture, by making the farmers more alert as to the service which science can render them.

The Agronomy courses are organised each year upon general propositions formulated by the agronomists of the State. Each course occupies fifteen lessons, the groups of which are as follows:—

Group.	Subject of Instruction.	Group.	Subject of Instruction.
1.	General conceptions of agriculture.	6.	Poultry raising.
2.	Rational feeding of cattle.	7.	Rural law.
3.	Zootechnics and hygiene.	8.	Elementary conceptions of rural economy.
4.	Rational treatment of milk, butter, and cheese.	9.	Mutuality and co-operation.
5.	Agricultural book-keeping and accountancy.	10.	Agricultural hydraulics.

For details of these, reference should be made to the body of the report. [Chap. XLI, sec. 22, p. 554.]

Courses

Courses in fruit-tree culture and in kitchen-gardening are also given, the courses covering fifteen lessons. These are arranged for the orchardist as follows, viz. :—

(1) General considerations; (2) notions of vegetable anatomy, organography, and physiology; (3) natural and artificial multiplication of fruit trees; (4) planting; (5) winter pruning; (6) viticulture and vine-pruning; (7) cultivation and treatment of the pear, apple, etc.; (8) the pear in espalier-forms; (9) the peach; (10) apricot, plum, cherry, and gooseberry; (11) fruit trees in the open; (12) generalities regarding the orchard; (13) summer pruning; (14) further generalities regarding orchard management; (15) packing, despatch, exportation.

There are courses in dairying, the scheme of management of which is of special interest.

4. *Belgian Short Courses in Dairying.*—The short-course dairying schools are in session for three or four months. The whole of the necessary material is furnished by the Government, and the schools are established either in a farmhouse, or in any habitation with a sufficient number of rooms for the proper installation. and the necessary cellars. For the butter-factory, the apparatus consists of two or three separators, hand-machines, pasteurisers, refrigerators, improved churns, butter-mixers, control apparatus (" creamometer," " lactodensimeter," " lactobutyrometer," Victoria, Babcock, and Gerber controllers, "lactofermentators," etc.) for the cheese-making; tables, drainers, double-bottomed vats, presses, cheese-shapes or moulds, etc.; and finally all the necessary accessories for the making of butter and cheese.

Not less than ten nor more than sixteen pupils are accepted, and *the course is absolutely gratuitous*, but the pupils must, if necessary, make their own arrangements as to board.[1] Two hours are devoted to theory, and three to practical work. The conditions of admission are that the young women shall be at least fifteen years of age, the young men shall be sixteen, and the possession of a sound elementary education.

The teaching staff consists of the following officers, viz. :—

(1) A director, charged with the courses of agronomy and zootechnics, responsible for the entire material organisation of the school, the selection of the locality, the purchase of milk, sale of produce, etc. These duties are undertaken only by State agronomists.

(2) The " dairy mistresses," who reside at the school. They are charged with the course in dairying, cheese-making, and book-keeping, and direct the practical work of the pupils.

The practical course is arranged as follows :—Each day 150 to 200 litres of milk are treated, part being converted into butter, part into cheese of the kinds locally the most suitable. All pupils take part in each kind of work in turn, being divided into four groups, whose several duties, changed weekly, are as hereunder, viz. :—

(i) Control of the milk and cream separation; (ii) churning and preparation of the butter; (iii) cheese-making, and its treatment in the drying-room and in the cellar; (iv) cleaning the instruments, etc., and the place.

The required milk is furnished by the people in the locality, or by the pupils' parents. The work is co-operative, each supplier taking the products and sub-products due to him. The system has, as one of its chief aims, *the demonstration of the advantages of co-operative dairying.* Twice a week the surrounding farmers are invited to witness the operation of the establishment, and to take account of the advantages of the new systems.

Two hours daily are given to the theoretical course. It is made as intuitive and attractive as possible, by means of the material which the teaching staff is able to exhibit; for example, collections of fertilising materials, of seeds, diagrams, microscopes,

[1] It is by no means essential that pupils should be boarded at the school, though such a scheme has advantages.

microscopes, herbarium material, etc. The pupils themselves make little collections of fertilisers, of oil-cake, of arable soils, and, as far as the season permits, of the gramineous, leguminous, and injurious plants to be found in the fields.

The theoretical studies are very varied, and relate to the principal ideas concerning good farming; for example, the choice and feeding of animals, the improvement of the fields, the use of fertilisers, the making milk, butter, cheese, etc.

The programme of instruction comprises *Dairying,* as hereunder, viz.:—

(1) Description and composition of the milk; change; adulteration; description of instruments for determining the value of milk and for the detection of fraud; the creamometer, lactodensimeter, lactobutyrometer, centrifugal controller, acidimeter, filtration, aeration, pasteurisation, sterilisation, cooling, weighing and measuring.

(2) Installation of a dairy, locality, water, etc.

(3) Sale and transport of milk.

(4) Manufacture of butter, quality of milk to employ, separation of the cream, different systems and their explanation, cream, churning, washing, preservation, packing, sending away, utilisation of by-products—skim-milk, thick milk, whey.

(5) Cheese-making—milk to be used, rennet, coagulation, theories of manufacture of different kinds of cheese, of foreign cheeses.

(6) Advantages of co-operation in dairying.

The other subjects treated are—*Zootechnics, pastoral agriculture, book-keeping*; and the students have access to a *library,* which contains a fairly large number of treatises on dairying, butter and cheese making, the hygiene and feeding of cattle, forage cultivation, domestic economy, arboriculture, etc.

For a more complete account, reference may be made to the body of the report. [Chap. XLI, sec. 27, pp. 556, 557.] Its practicality and value are obvious, and each province of Belgium possesses its dairying school.

During four months of the year every Belgian soldier, so desiring, may attend a course of instruction in agriculture [sec. 23, p. 555].

The thoroughness of the course in *farriery* is worthy of note. [*See* sec. 24 p. 555.]

5. *Farming Schools of Austria.*—The farm schools of Austria *(Ackerbauschulen, Wiesenbauschulen, etc.)* have courses ranging from 1½ to 3 years—usually of 2 years,—and embrace continuation work, carrying on the work of the ordinary elementary school to a higher plane, manual instruction in carpentry, joinery, etc., wheelwright's work, basket-weaving and similar matters. The courses last throughout the year.

There are also Winter-schools where young farmers or farm-labourers study during the winter months. These have one or two year courses with sometimes a one-year course, with a second optional year.

The Austrian Dairying Schools (*Molkereischulen, Meiereischulen*) are differently organised, and their aim is to improve the art of dairying.

It may be mentioned that in the Country Housekeeping Schools (*Haushaltungschulen*) the instruction embraces the mode of housing cattle, etc., the management of dairies, kitchen-gardening, fruit-culture in small orchards, the utilisation of fruit, etc., together with housekeeping proper.

6. *Special Schools in France.*—France possesses a number of special schools in subjects connected with agriculture; for example, a great National School of Horticulture, of Agricultural Industries at Douai, of Dairy-farming at Mamirolle, etc. The farm-school of France is disappearing and a higher type taking its place.

Special attention is often paid to artificial pasturage, as well as to the cultivation of cereals, the growth of industrial crops, particular fodder plants, viticulture and œnology, the cultivation of the olive, and oil extraction, etc.

It may be stated that the influence of the National Agronomic Institute is steadily raising the character of French agricultural education.

7. *Some Features of German Agricultural Education.*—In Germany there is a type of school known as a farming school for youths who have already learnt something of farming. The number allowed in any one school is limited to twelve. These schools are managed by an educated practical farmer, who as "Director" rents a farm of about 300 or 400 acres, and cultivates it at his own risk as State tenant, though as long as he is Director he is a State official.

The Director's duties are to give instruction in agriculture, and in subordinate and allied subjects; to superintend other branches of instruction, and to maintain discipline; to work the estate, as regards products and methods, in such a way as shall agree with a plan of instruction fixed by the authorities. He is assisted by an instructor; a farming inspector, and a veterinary surgeon. The course lasts for three years; the pupils must be at least 17 years of age, vigorous, and healthy, and must have qualified in the lower schools. They must, further, understand ordinary farm work. The pupils give their labour in the practical work of the farm, and study and work under the following conditions, viz.:—They do not pay fees; they are provided with board and lodging gratis; they are required to work ten hours in summer, eight in winter, but at harvesting two more hours are required; their work must be executed diligently and carefully; they must be punctual; they have no regular holidays, though short periods of absence are granted on application. Food is supplied by the Director in return for the work performed by the pupil.

The instruction covers the following range, viz.:—

Theoretical and Practical.—(a) Climatology; soils; plant, fruit and grape cultivation; grass and hay growing; breeding domestic animals; instruction in agricultural trades; stocking and working farms; keeping books and accounts. (b) German composition; arithmetic; geometry; elementary natural science; general subjects.

Practical.—Handling agricultural machinery; beetroot cultivation; irrigation and drainage; regulation of brooks and streams; manuring, sowing, harvesting, hop-growing; threshing, cleaning, measuring, packing of grain, fruit, etc.; repair of machinery, tools, etc.

It will be seen that this class of instruction, designed for small farmers, is eminently practical, and the Director, having to make his farm pay—for it is at his own risk,—is under every inducement to adopt good practical methods. At the same time, he is under some temptation to sacrifice the interests of his students to his personal interests. Thus the method does not reach the highest grade of educational efficiency.

During the period of heavy work, as at harvesting, theoretical instruction is postponed; this is, however, no disadvantage. Of course, the obvious defect is that the financial aspect has always to be present to the Director, and he may be tempted occasionally to sacrifice the educational aspect thereto. On the other hand, there is no temptation to undertake merely theoretical experiments, important, of course, in higher schools undertaking research, but beyond the educational qualifications of those of lower grade agricultural schools.[1]

Some of the schools are restricted to special forms of agriculture; for example, such an institution as the grape-culture and vine school at Weinsberg. The object is, for example, to afford instruction in viticulture, wine-making, plant and tree-growing, etc. These schools are directly under the supervision of the Royal Bureau of Trade and Commerce, which nominates the pupils, limited to twelve at each school. The schools are *free;* so also is the boarding and lodging therein. The course is two years. The pupils give their labour on the attached estate (about 85 acres), receiving a small honorarium on leaving. The expenses are borne wholly by the State. The instruction covers about the following range, viz.:—German, arithmetic, geometry, drawing, elementary chemistry, physics, mechanics, climatology, soils, manures, the use of implements, tools, etc.; viticulture; wine-making and storage; fruit, vegetable, hop, and tobacco growing; the breeding of domestic animals; and farm management.

8.

[1] These schools are regarded as elementary schools. It should be mentioned that instruction of the grade given in the Hawkesbury Agricultural College would be regarded as higher elementary in Germany and France—hardly as secondary, because of the brief length of the course, and insufficient entrance qualification.

8. *Travelling Lecturers in Agriculture.*—Throughout Germany travelling lecturers disseminate important agricultural information by a system of local lecturing, having for its object the stimulation of the peasants and small farmers, so that they may do their work rationally and be led to make experiments. The lecturers are often officials in the pay of the Chamber of Agriculture, or of the larger agricultural societies; sometimes they are masters of the lower agricultural schools. The Royal Bureau for Trade and Commerce promotes and assists activity of this kind.

The lectures range over a variety of subjects—such, for example, as fruit culture; viticulture; tobacco growing; the breeding of domestic animals, of poultry, of fish; field products, meadow and garden products; artificial manuring, drainage, etc., etc.

When it is borne in mind that the lecturers are suitably educated and thoroughly practical men, with genuine agricultural experience, it is obvious that the results of such lecturing must be very valuable. It should be borne in mind that there is a great difference between the teaching of men whose earlier education has been thorough, and who then specialise, and that of uneducated or of poorly-educated men, who are merely a little above the average in practical agriculture or general information. It is the well-educated man who can give the most valuable help, and everything depends upon the recognition of the power to be of real service to the practical farmer, etc.

9. *Public Spirit in Italian Agricultural Education.*—So earnestly did Dr. Guido Baccelli, the Italian Minister for Education, urge the importance of a more widely-extended scheme of agricultural education, that land-owners gave gratuitously over 6,000 little experimental plots, the value of which is at least £50,000.

Not only did landed proprietors respond to the public appeal of the Minister, but school authorities, teachers, farmers also liberally helped. Teachers attended in thousands to hear lectures, and a very large number—about 2,000 in one year—of lectures were given by University professors, professors in the technical "institutes," the directors of practical or special schools of agriculture, prominent agriculturists, agricultural engineers, and similar persons.

This elementary instruction touched upon the modern knowledge of the part played by bacteria, leguminous crops, rotation, the economic importance of manuring, of fertilisers, of tilth and of farm implements and machinery, the significance of seed-selection, the necessity of a study of climatological and meteorological conditions, the nature of plant diseases, and the treatment and eradication of the same.

In order that teachers should be able to deal with such matters in the primary schools, not only were the special lectures referred to given, special instruction was also afforded in the normal school. This instruction covered a very wide range, and, among other matters, touched on the following, viz.:—The difference between arable and uncultivated lands; the nature of subsoils; the consequences of drainage and of irrigation; the significance of tilth, of the use of machinery for that purpose; the conservation and use of stable manures, and the use of chemical fertilisers; the cultivation of cereals, of textile, dye, oil-bearing, and aromatic plants; meadow-cultivation; orchards; the diseases of trees; insect pests; the drying and conservation of fruits; viticulture, including site and soil selection; various kinds of vine and their propagation; vine diseases, etc., wine-making, vitiation of wine, and its remedying; cultivation of the mulberry and propagation of the silkworm; olive cultivation and the extraction of the oil; apiaries; the dairy and poultry yard; the rearing of cattle and pigs, etc.; hygiene; elementary toxicology; and also such subjects as book-keeping, accountancy, etc. The value of this instruction in Italy is believed to be very great, and justly so.

10. *Special Schools in other Countries.*—One of the most interesting laboratories for agronomical experiments visited by the Commissioners was that of Copenhagen, established for the purpose of securing a permanently satisfactory character for Danish butter and dairy products. A map shewing all the dairies in Denmark and the central control stations is kept in Copenhagen, so that the control can be thoroughly organised, the object being to maintain uniformity of quality. When any defect is observed, the farmer supplying the product is duly advised as to its correction; and the grading and treatment at the central station is such that

Danish

Danish butter now has a well-established reputation for excellence in foreign markets. We would do well to have a similar station, controlled by the same class, viz., by accomplished scientific experts, whose original contributions to science are of great value, and who are not merely superior dairymen. The success achieved with Danish butter is due to the original scientific researches of the scientific experts at the Copenhagen laboratory.[1]

The farming or agronomical schools of Sweden are adjuncts of higher primary schools, with a definite orientation of the teaching towards agriculture, and the winter schools of farming have courses lasting from five to six months, the pupils being required to have had a good primary education, and to have been engaged twelve months in an agricultural calling.

The dairying schools of Sweden are variously organised. At Alnarp, for example, there is a dairying institute with a higher school which demands as a preliminary qualification two years' attendance at an agricultural school, and one year's experience in a dairy; and a lower school, for which one year's dairy experience is also demanded, and a primary school education. The age must be at least 19. Only twelve pupils are received in this type of school, the fees being respectively £33 and £22 per annum For further information, reference may be made to the body of the report. [Chap. XLII, sec 34, p. 571.][2]

In Switzerland the practical school for cheese-making (*école pratique de fromagerie*) of Moudon was one of the finest seen by the Commissioners, the new building being very perfect. The whole place represented the best features of electric installation for power and light, and the means for scientific control and examination of the work was all that could be desired. There are a number of dairying and farming schools, schools for viticulture, gardening, etc., for which reference may be made to the body of the report. [Chap. XLIII, sec. 12, p. 579.]

11. *Importance of Various Courses.*—Every person who can devote the time thereto would receive a distinct and sufficient advantage by passing through a complete agricultural course if he desired to engage in agriculture. Nevertheless, in view of some degree of specialism in actual practice—dairying for example,—and of limitation of time or means, it is advisable that a large number should be induced to learn merely scientific dairying, viticulture, œnology, sheep and stock-breeding, and so on. This shews the necessity and value of short special courses and of lectures. The men appointed need, however, to be excellently trained so as to command respect, and eminently practical so as to demonstrate beyond question the economic value of the course.

Every country in Europe has satisfied itself that a liberal system of agricultural education is necessary from the standpoints of economics.

The lecture courses referred to in section 8 of this Division are esteemed of great value, and keep agriculturists in touch with the world's progress, not merely that which is local. The lecturers are competent to demonstrate when necessary, and this enhances the value of their work.

---

[1] The work of Professor V. Storch, N. I. Fjord, and others is known to all competently-informed experts.

[2] The part Sweden has played in the improvement in the modern dairy is well known. R. Tornérhjélm, at Gedsholm in Skåne in 1840, developed what is known as the Holstein system of separating the cream. The P. U. Gussander [1793–1871] system was also tried. Then in 1864, J. G. Swartz's [1819–1865] ice-method was invented and became popular in Austria, Denmark, Finland, Germany, Norway, etc. This was supplanted by the modern separating system, 1878. Dr. Gustaf de Laval's *Separators*, C. A. Johansson's *Extractor* 1887, A. Wåhlin's *Accumulator*, and E. G. N. Salenius' *Radiator* are probably too well known to need more than mention.

X.

ELEMENTARY AGRICULTURAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—In Europe, such a type of education as is provided, for example, at the Hawkesbury Agricultural College, would rank lower than secondary, and somewhat higher than elementary. When, in the future, the students enter that college properly qualified, it will naturally develope into a secondary agricultural school, in the stricter sense of the word. This is not in any way the fault of the administration, but is due to the fact that our whole school system is not yet satisfactorily organised. Many lads entering the college are weak even in arithmetic (!), and, speaking generally, they have either very hazy or no notions of the sciences, *i.e.*, of physics, chemistry, geology, botany, and zoology, etc.

The term Elementary Agriculture is also occasionally applied to instruction which, though not strictly systematic instruction in the subject, is more or less definitely orientated in regard to agriculture. Such instruction is to be found in the primary, or even in secondary, schools. Work like that being done by Mr. John Halstead, of Eglinton, near Bathurst, is also known by the same term.

It may be mentioned that there is a widespread and growing belief in educational circles that the direct observation of nature, as an essential of education, has an importance which in the past has been wholly overlooked. Practicality depends upon real, as distinguished from mere literary knowledge, and the world is coming to recognise that it is to the men who observe, think, and translate their thought into act, rather than to those who are erudite concerning the achievements of others, that the progress of mankind is to be ascribed. Hence direct nature study, manual exercises, laboratory practice, and all similar forms of direct study practical effort are highly appreciated in modern educational method.

2. *References to Agricultural Education in the Interim Report on Primary Education.*—Important references are made to elementary agricultural education in the Commissioners' Primary Report. Those by the Commissioner here writing are as follow :—

REFERENCES TO AGRICULTURAL EDUCATION IN THE INTERIM REPORT ON PRIMARY EDUCATION.

Chapters.	Sections.	Pages.	Refers to
V	7	41, 42	Nature Study, Schools of Geneva.
,,	10	49, 50	Natural History, Zoology, Botany, Mineralogy, Geology, Animal and Vegetable Physiology, Canton of Vaud.
VI	6	54, 55	The teaching of matters relating to the field, farming, etc., in German Schools.
,	18	61, 62	Natural History in German Elementary Schools.
,,	26	66	Teaching of Fruit-growing in German Elementary Schools.
,,	38	76	Theory of Agriculture in Belgian Communal Schools.
,,	42	77	Rural Economy in Hungarian Primary Schools.
,,	43	78	Agricultural teaching in the French Primary Schools.
VII	10	82, 83	Agricultural Education in Russia.
XXXV	2	331	Theoretical and Practical Agriculture and Horticulture for French teachers in Training Schools.
,,	11	335	Natural Science and Hygiene for French teachers.
,,	13	336	Agriculture, Zootechnics, and Rural Economy for French teachers.
XXXVIII	5	345	Theoretical Instruction in Agriculture given in nearly all normal schools for primary teachers, Switzerland.
XLVII	21	416, 417	Necessity for Gardens as adjuncts to schools.

It is desirable that these passages should be referred to, for they will disclose how very different is the preliminary qualification for learning agriculture in Europe from that in New South Wales.

3.

3. *The Training in Agriculture of the French Primary Teacher.*—In general matters, it is desirable that we should not continue the self-deception which led us to regard our primary education as the best in the world. In the matter under review, it is specially important. Let us refer for a moment to the education of the French primary teacher, in so far as it qualifies for an intelligent understanding of agriculture, and compare it with the so-called training of our own primary teachers.

The French teacher has three years of *Physics*, viz. :—Gravity, hydrostatics, acoustics, heat, meteorology, electricity, magnetism, optics, and mechanics. He has three years of *Chemistry*, inorganic and organic. He has one year of *Botany*, including organography, vegetable physiology, theory of fecundation, classification; one year of *Zoology*, including human anatomy and physiology, the classification of animals; one year of *Geology*, including general and stratigraphical geology, palæontology. This by way of general preparation.

During the second and third years of his training he has special courses in *Agriculture*, *Zootechnics*, and *Rural Economy*, as follows :—

(I) Soil, its modification, chemically and physically, manuring, amelioration, irrigation, drainage, working.
(II) Growth of special crops, cereals, leguminous plants, forage and industrial crops, rotation.
(III) Feeding and care of animals, breeds of horses, cattle, sheep, pigs, etc.
(IV) Rural economy, landed property, method and capital of exploitation, book-keeping and accountancy.
(V) Horticulture, site, soil, planting, culture, various trees and the vine, grafting, the kitchen garden, etc.

He also learns *plane and solid geometry, trigonometry, surveying, plan-drawing, and field-surveying*, the courses extending over three years. He also has manual training in wood and iron. [See Interim Report, Chap. XXXV, Secs. 9, 10, 11, 13, 17, pp. 334–337]. And such instruction is given by highly competent instructors.

The science taken is equally good in other countries. For example, in Zurich, in Switzerland, the teacher during training is instructed in botany, zoology, chemistry, inorganic and organic, mineralogy, geology, general physics, mechanics, heat, acoustics, optics, magnetism, electricity. This knowledge is not merely bookish, it is experimental.[1]

In other countries, the instruction is equally thorough, and for the simple reason that the teachers are trained by men of higher education than their own order before they undertake professional work as teachers. Hence they are well qualified to give elementary instruction in the sciences. In this State, although there are exceptions, teachers as a whole are *not* so qualified,[2] for they have neither had the advantage of a good secondary education of European standard, nor of professional training. This is the fault, not of the teachers, but of the State system.

4. *Principle governing elementary agricultural instruction.* It is important that we should guard against any attempt to turn the primary school into a technical school. *Really practical education* involves thoroughness. The problem with which we have to deal in this state, viz., to promote a disposition to "go on the land," to engage in agricultural pursuits, has presented itself in other places, as, for example, in France and in Germany. It is set out in the Interim Report quite clearly and definitely [Int. Rep., Chap. VI., Sec. 43, p. 78]. A commission dealt with the matter in France and gave it distinct form. The official instructions are to this effect, viz. :—

The ideas of agriculture in the elementary school are addressed less to the memory than to the intelligence, and are intended to direct the pupils' attention to the everyday facts of agricultural life, and to elucidate the fundamental scientific notions underlying the more important agricultural operations. The "why" is important, not details, definitions, and agricultural recipes. The rationale of hygiene, both as regards man and domestic animals, is regarded as of value. The use

[1] "The acquisition of so much knowledge of system and classification as can be included in a text-book of science is really becoming to be regarded as so much 'examination fodder,' having no further value than the attainment of a diploma." This is the expressed view of Herr Wilsdorf, of Plauen. [See Chap. XL, Sec. 27, p. 536.]

[2] It is true that many teachers are making admirable, earnest, and most self-sacrificing efforts to stand on a higher plane of qualification, and are making good the defects of their education and training under the departmental system.

use of a manual of agriculture is to be deprecated; what is wanted is direct observation and reasoning. A taste for, and understanding of, agricultural matters is that which the instruction is intended to create. The object to be attained is therefore to initiate a large number of country school children into such elementary knowledge as is indispensable for reading with profit a work on modern agriculture, or for following an agricultural discussion; and to instil *a love of country life*; *to make the pupils realise that the calling of the agriculturist for intelligent, properly instructed, and practical workers, is far more independent and remunerative than many others.*

The tone of this is healthy, but it is easy for those who do not know all the facts to draw a wrong inference, viz., that practical education for the farmer's son is education which abandons generality and specialises in agriculture. This inference would be erroneous. Education in the primary school must retain generality if the best results are to be achieved, but this generality in no way prevents the orientation of the nature-study, natural history, and general science teaching, so that it will be of direct practical value, and of special application to local industrial conditions. To ensure this orientation, and at the same time maintain general efficiency, well educated and trained teachers are wanted.

5. *References to Elementary Agricultural Education in present Report.*—The following passages refer to the various grades of elementary agricultural instruction mentioned by the Commissioner here writing.

REFERENCES TO ELEMENTARY AGRICULTURAL INSTRUCTION.

Chapters.	Sections.	Pages.	Refers to.
XX	5	224	Nature-study and agricultural instruction at Tuskegee, Alabama.
,,	,,	225	Nature-study and gardening at Tuskegee.
XL	20	531	Elementary agriculture of educative rather than utilitarian character and aims in Germany.
,,	21	532	Various types of so-called elementary agricultural schools giving general or special instruction in Germany.
,,	22 to 25	532, 533	Several classes of agricultural schools regarded as elementary in Germany.
,,	26	534, 536	Natural history and instruction in agriculture at Geistingen, in Germany.
,,	27, 28	536	Advantages of elementary agricultural instruction, and the training of primary teachers.
XLI	9	545	Instruction for teachers of elementary agriculture.
XLII	11	561	Farm schools of Austria, known as elementary.
,,	32	570	Continuation course in agriculture, Swedish schools.

An account is given by one of the Commissioners [Mr. Turner] of agriculture in the primary schools of the State, to which reference should be made. [Chap. XLVIII, pp. 663–679, pp. 681–683, pp. 683–684, pp. 684–685.]

6. *The Significance of Elementary Agricultural Teaching in New South Wales.*—The very fine results attained by Mr. John Halstead at the Eglinton School are significant in several respects. He has had, in many ways, a unique experience. He obtained some knowledge of agriculture in England, but that was supplemented by a study of Belgian dairy farming, Dutch horticulture, etc., Spanish fruit-growing and curing, kitchen-gardening, irrigation, etc.

Whatever opinions may be held as to the wisdom of adopting the system followed by Mr. Halstead as a general and ideal one, he has at least demonstrated several important things, which are becoming more and more clearly recognised in educational circles. These are as follows:—

(1) The immense value of experience of the better educational ideals of other countries. [This is seen in the fact that much of Mr. Halsted's initiative and power as a teacher, and his freedom from mechanicalism, are due to the influence of what he had seen and learnt elsewhere. His experience has translated itself into his work as a teacher.]

(2) The importance of the previous training system of Europe and America, which, up to the time of writing, has not been put into force for all incoming teachers in the Public Instruction Department. [The success of the agricultural work done by Mr. Halsted's pupils really reflects his *acquired knowledge* of the subject, and the enthusiasm which such knowledge both confers and inspires.]

(3)

(3) Self-activity is essential for the thorough arousing of the pupils' interest. [No one can read of the achievement's of Mr. Halsted without seeing that Froebel's dictum, as to the necessity of self-activity, is an established truth. Children must express themselves in deeds as well as in words; real education must train the mind to express itself through the hands as well as through the tongue.]

(4) The unqualified importance of correlated studies. [The Nature study involved in the work of the pupils makes them recognise the interdependence of the things of Nature, and the connexion of the sciences. Thus, where their instructor is competent, they learn in a profoundly interesting way something of botany, geology, zoology, chemistry, physics, etc., and their own observations can be made the starting point for further instruction, and they learn these things, not in an isolated way, but as a series of interdependent facts.]

(5) The value of an intelligent use of the heuristic method, and of following a method which recognises that education must be self-evolution. [Mr. Halsted excites the interest of his pupils in observing the relation of things; they are alert to Nature as it surrounds them; their powers of initiative are called upon; their interest in their tasks is intense.[1] These are the conditions under which pupils progress.]

Other teachers have similarly got satisfactory results, by the adoption of similar methods.

The public significance of this fact is, that it discloses in a conspicuous manner how important is a principle recognised by educationists in Europe and America, viz., that the proper orientation of instruction in science is of great practical value; further, that elementary science is a necessity in primary instruction, if that instruction is to really equip for life's work.

7. *The Importance for Agriculture of Elementary Science in the Primary Schools.*—The fundamental importance of good primary schools, and of the proper professional training of teachers to staff them, is perceived at once when the after issues are taken into account. The prevailing educational idea of this State has not gone very much further than the three "R" view, viz., that a public system of education is called upon to provide instruction in reading, writing, and arithmetic, and but little else. Our schools, as a whole, are not equipped for effective science teachings with demonstrations, in physics, chemistry, botany, zoology, or geology, nor are our teachers, *as a whole*, trained in a recognised way to teach these subjects. Hence, children on leaving the primary schools are, as a rule, quite innocent of any such knowledge, even the most elementary, of the sciences.

To enter intelligently upon agricultural pursuits, or higher agricultural instruction, some knowledge of elementary science is however an essential; in Europe and in America this is obtained in the primary school. Teachers are trained to teach these subjects, and during their professional training, *not only receive instruction therein, but also in the method of teaching them.* Owing to this, the pupil is better prepared elsewhere for agricultural instruction, and for an agricultural life, than he is in this State, and *we cannot hope for the satisfactory results attained in the agricultural schools of Europe, until the primary system of the State has been radically altered, which it has not as yet, in the direction pointed out in the Commissioner's previous Reports.* Nothing but a "previous training system," and equally well-equipped schools will put our system in the fairway to success.

8. *Concluding Remarks on Elementary Agricultural Education.*—From what has been stated it may be seen that it is essential, if we are to have primary education which in any way approaches that of the countries of Europe, and which will help agricultural and industrial pursuits, to make provision for the scientific education of teachers, in *specially organised schools for their thorough professional training, including training in science,* as in other countries. Attendance at a University, merely, is *not* training of the kind required; the explanation of this was indicated in the Report on Primary Education. In

[1] The testimony of children as to the effect of interest in their lessons is very remarkable. They do not tire of their tasks, though they actually think more earnestly.

In the training-school for teachers, the general method of orientating the scientific instruction, so that it shall be of local interest, value, and touch with the probable after-life of the pupils, can be taught and illustrated. The work of Mr. Halstead and others shews the great practical value of such orientation, as well as the ethical and pædagogic value of such methods of instruction. The proper results to be expected from special agricultural teaching will not be realised until we radically improve our primary system; and we shall remain behindhand until we do so improve it.

It is obvious that in countries where the teachers are more highly educated and trained, and where the schools are adequately equipped for the teaching of science, where the school buildings are arranged with separate class-rooms, allowing of more perfect concentration of attention, that the necessary foundation for agricultural as well as for all other forms of technical education, can be better laid than they can in our State at the present time, and if our educational system is to be the peer of the better systems of the world, then it must be possible for teachers generally to achieve, not only in agriculture but in other directions, what the genius of only a few has reached, viz., such results as Mr. Halsted and some few others have obtained—results which are not due to our scheme of education, but which stand out as exceptional, and as the result of personal ability and devotion.

Many inspectors and teachers have the necessary devotion to give an agricultural and industrial orientation to scientific instruction; but until we have a thorough system of professional training for teachers, our educational effort will be crude and often misdirected, and in unwise hands elementary agricultural instruction may degenerate into an attempt to turn the primary school into a technical one, instead of representing an orientation of scientific teaching.

XI.

COURSES IN ZOOTECHNICS, FARRIERY, VETERINARY SCIENCE AND MISCELLANEOUS SUBJECTS CONNECTED WITH AGRICULTURE.

[G. H. KNIBBS.]

1. *Introductory.*—There are a number of subjects more or less directly connected with agriculture, instruction in regard to which is usually provided in agricultural universities, colleges, or schools, or which are considered in some sense agricultural subjects. These will be referred to here.

2. *References in the Report to Zootechnical and Veterinary Science, etc.*—The proper care and feeding of animals is everywhere regarded as distinctly important in connection with agricultural pursuits, and it seemed desirable therefore, to afford clear evidence of the excellent instruction which it is deemed desirable to afford agriculturists. The following references in the body of the Report relate to matters of this kind, viz.—

COURSES IN VETERINARY SCIENCE, ZOOTECHNICS, FARRIERY, ETC.

Chapters.	Sections.	Pages.	Refers to
XXXIX	20, 21	473	Veterinary Hygiene, University of Edinburgh.
,,	27	477	,, ,, ,, Glasgow.
,,	28	478	,, Science, ,, Ireland.
,,	29	478	,, ,, ,, College of Wales.
,,	30	479	,, Hygiene ,, ,, North Wales
XL	2	519, 520	,, Medicine and obstetrics at Agricultural High School, Hohenheim.
,,	8	523	,, Science, Berlin Agricultural High School.
,,	21	532	Schools for courses in breeding animals, in shoeing, etc., Prussia.
XLI	3, 6	539–541	Zootechnics in the Agricultural College, Wageningen, Holland.
,,	8	543	Four-year course in State Veterinary College at Utrecht.
,,	10	545	Cattle-breeding, etc., in Winter Agricultural Courses, Holland.
,,	15	548, 549	Zootechnics at Agricultural Institute, Gembloux, Belgium.
,,	17	550	State School of Veterinary Medicine, Brussels.
,,	18	550	Zootechnics in Secondary Agricultural Education, Belgium.
,,	21	553	,, Agricultural Sections of Secondary Schools, Belgium.
,,	24	555	Courses in Farriery in Belgium.
,,	27	556, 557	Zootechnics in connection with Belgian Dairy Schools.
XLII	7	560	Breeding of Animals in Austrian Secondary Agricultural Education.
,,	18, 19	563, 564	Curriculum in Veterinary Science, Copenhagen, Denmark.
,,	35	571	Veterinary Institute and Farriery in Stockholm, etc., Sweden.
XLIII	7	577	General Zootechnics at the Agricultural Institute of Lausanne, Switzerland.
XLV	6	625–628	Course in Zootechnics in the National Agronomical Institute of France.
,,	7	628–630	Practical ,, ,, ,, ,,
,,	20	642–644	Hippology ,, ,, ,, ,,

The above list is not quite complete, but is sufficiently so to give a fair indication of how far the report deals with the subject matter. The curricula of various schools are given with sufficient detail to reveal the excellence of the instruction. The fullest treatment will be found in Chapter XLV, which very fully outlines the instruction given in France, and illustrates European traditions as to thoroughness of teaching.

3. *Miscellaneous Subjects treated in Agricultural Courses.*—In agricultural schools, and agricultural courses, a number of subjects are usually treated which do not fall directly under the head of agriculture. They may be included under the head of agricultural technology, however, since they have a more or less direct relation with agricultural occupations, or husbandry in general. The

The following list gives the more important references to such subjects :—

COURSES IN MISCELLANEOUS SUBJECTS MORE OR LESS CONNECTED WITH AGRICULTURE.

Chapters.	Sections.	Pages.	Refers to
XXX	43	234	Agriculture at Tuskegee, Alabama.
XXXIX	8	467–8	British School of Malting and Brewing, Birmingham University.
„	41	487	Course in Brewing, Manchester School of Technology.
„	52	493	Courses in Brewing, Germany.
XLI	6	542	Pisciculture in the Agricultural High School, Wageningen, Holland.
„	15	549	Pisciculture at the Agricultural Institute of Gembloux, Belgium.
„	18	551	„ in Secondary Agricultural Education, Belgium.
„	18	551	Milling, distilling, brewing, sugar-refining, etc., Belgium.
„	26	556	Agriculture in Belgium.
XLII	7–10	560, 561	Academy for Brewing Industry, Vienna.
XLV	8	630	Aviculture (Poultry, etc.) in the National Agronomic Institute of Paris.
„	12	632–634	Agricultural Technology, beet and cane sugar, starch and feculas, wine and cider making, brewing, distilling, milling, oil manufacture, production of perfumery, turpentine, charcoal, manure, retting of textile plants, conserves, milk industry, margarine production, cheese-making; at the National Agronomic Institute of France.
„	19	642	Pisciculture, etc. (agriculture), in the National Agronomic Institute of France.

The above will be referred to more fully a little later. We return to the first list.

4. *Zootechnics.*—Zootechnics, as understood in European education, is that which concerns the theory of breeding, feeding, and the general care of such animals as are of importance to the human race. The scheme of the teaching is to point out the significance of animals to agriculture, in virtue of the interrelations between animal and vegetable products; to indicate the economic and biological questions which arise in connection therewith; the theory of the whole scheme of feeding; of the hygiene of animals; the necessity of exercise; the laws of reproduction and breeding; of the production of animals for special purposes, as for food, for milk and milk products, and so on.

The work is divided into the theoretical part, consisting of—(*a*) general and (*b*) special zootechnics, and the practical part consisting of (*c*) preparatory exercises, and then (*d*) special studies, viz., of the organs generally, and then of particular animals.

The theoretical part is concerned with a study of the general theory of nutrition, of feeding, of exercise, environment, etc., of heredity, and of disease.

In the *theory of nutrition*, the chemical composition of the body of animals and of the chief nutritive principles, the exchanges between an organism and its environment, the determination of the gross and net value of various foods, the classification of aliments, their physical and chemical form, specific action, preparation, etc., their substitutes, and the composition of rations, are all dealt with very fully.

In connection with the subject of *variation*, the influence of functional gymnastic is treated, as regards its action on the digestive apparatus, the apparatus of lactation, of locomotion, and the mental nervous apparatus. The influence of environment on domestic animals, the amplitude of so-called spontaneous variation, and the zootechnical interest of these are also studied in the same connection.

The treatment of *heredity* refers to its general theory; it touches transmissibility of acquired characters, of mutilation, imperfection or disease, of sex; it deals with unilateral, bilateral, and ancestral heredity, with the combined effect of artificial selection and consanguinity; with the physiological and morphological elements of species, the importance of race with reproduction, crossing, hybridisation, the intervention direct or indirect of the State in these matters.

Disease is treated very thoroughly, and the significance of micro-organisms, of hygiene, of the destruction of pathogenic organisms, of asepsis, of disinfection, and of isolation, are explained. Tuberculin and mallein and their role in coping with tuberculosis and glanders, natural and acquired immunity, phagocytosis and antitoxic action, vaccination and serotherapy, the function of sanitary police, various diseases, contagion and defence against it, and assurance against mortality of cattle, are very fully discussed.

In

In *special zootechnics* the various breeds of cattle, of sheep, goats, pigs, and horses, are examined; their breeding, rearing, production of work, milk, and meat, of wool and hair; their hygiene, grooming, shoeing, castration, etc., are all treated of fully.

The *practical exercises* in zootechnics relate to the bones and their form, structure, surfaces, chemical composition; their use after death, growth; the comparative anatomy of the teeth of homo- and heterodontal animals; dental formulæ and age; frauds by way of ageing and rejuvenating; the age of the horse, mule, ass, ox, sheep, pig, etc.; to the digestive, respiratory, circulatory, genito-urinary, and locomotor organs; to the handling, examination, and conformation of animals; to the diagnostic signs of health or disease, the determination of race, etc.

For fuller reference to the subject, reference may be made to various parts of the report [in particular to Chap. XLV., secs. 6, 7, pp. 625-630].

In the different classes of school the range is much the same, but the treatment differs greatly in thoroughness.

5. *The Value of a thorough Course of Zootechnics.*—Persons who have passed through the higher courses in zootechnics in Europe, are prepared to deal rationally —not merely empirically—with any problems which occur in the raising or breeding of stock of any kind and for any purpose. For example,—the breeding of the best kind of cattle for meat, for draught, or for dairy products, can be conducted on definite principles; similarly in regard to the production of sheep for mutton, for wool, for special kinds of wool, etc. A study of the curriculum outlined in the chapter last quoted will disclose at once the great value of a thoroughly scientific and properly organised course in zootechnics, for the agriculturist, the horse, cattle, or sheep breeder, etc.

6. *Farriery.*—The general treatment of this subject is sufficiently indicated in several places in the Report [*see* Chap. XLI, sec. 24, p. 555, and XLV, sec. 20, p. 643]: Commencing with an historical aperçu, the courses usually deal with the utility of shoeing; the anatomy of the hoof, its internal parts, the horny part of the hoof, its wall, sole, frog, etc.; the differences between the two halves, and between the front and rear part of the foot, its proportions, straightness, physiology, elasticity and nutrition, with ordinary shoeing, the making of the shoe, instruments for shoeing, the preparation of the hoof, the handling of horses; racing and hunting shoes. Ordinary is compared with physiological shoeing, and descriptions are given of the principal physiological shoes. The mode of shoeing for ice; a description of the principal systems, the advantages and inconveniences of each of them, are necessary in Europe. Corrective shoeing for faults of proportion, for faults of shape, etc., or for retroverted heel, flat-foot, and other such defects, is carefully handled. False aplomb of the foot, crooked-leg, splay-foot, toe too low, club-foot, foot down on the internal quarter, on the external quarter, are dealt with by appropriate shoeing. Pathological, protective, surgical, and orthopædical shoeing, and the shoeing of the ass, mule, and bullock, and an aperçu of foreign systems of shoeing, are also dealt with.

Thus it will be seen that the courses are really thorough.

7. *Veterinary Science.*—The courses in veterinary science, hygiene, medicine, etc., vary between courses of the most elementary kind, constituting little more than a few suggestions on the subject, to elaborate professional courses of the highest character. For example, the course in veterinary medicine and surgery in the University College of Wales, Aberystwyth, is extremely elementary, while those of Denmark, France, Sweden, etc., are very advanced.

The course in Denmark is 4 years. In the first year the following subjects are taken, viz.:—

> Mechanical physics and optics, chemical physics, inorganic and analytical chemistry, organic and analytical chemistry, botany, zoology, domestic animals, the anatomy and breeding of domestic mammalia; and the laboratory practice, demonstrations, etc., include chemistry, botany, and the care and use of the horse.

In

In the second and third years are taken:—

Anatomy, physiology, domestic animals, the theory of shoeing, pharmacognosis and pharmacy, general pathology, special pathological and therapeutics, general therapeutics and pharmacodynamics, pathological anatomy, and surgery. The laboratory practice, demonstrations, etc., include pharmacy, theory of shoeing, dissection, normal histology, form and structure, and clinics.

In the fourth year the course runs as follows, viz.:—

Special pathology and therapeutics, general therapeutics and pharmacodynamics, pathological anatomy, experimental pathological anatomy, surgery, obstetrics, veterinary law. The exercises and experimental work include clinical station, dissections, pathological histology, bacteriology, surgical operations, and obstetrics. Besides this there are laboratory practice, with demonstration, etc., a travelling clinic, veterinary law, inspection, etc., of meat for consumption.

It will be seen that the professional thoroughness is of a very high character indeed. [Chap XLII, sec. 19, pp. 563, 564.] The four-year course at the State Veterinary College of Utrecht, in Holland, is of much the same character. [Chap. XLI, sec. 8, pp. 543, 544.]

8. *Veterinary Science in the State of New South Wales.*—In connection with the courses in the Hawkesbury Agricultural College, etc., a little elementary instruction in veterinary science and practice is given.[1] The students are, of course, not sufficiently advanced to go through a course of the type above referred to; but what is given is appropriate. [Chap. XLIX, pp. 694, 695, 701.] To equip the University so as to extend its function to include the highest grade of instruction in this science would not involve a very large expenditure, and, if agricultural and pastoral pursuits advance, will become necessary.

At present skilled veterinaries do not appear to be greatly in demand.

9. *Miscellaneous Subjects Connected with Agriculture.*—*Apiculture* is a subject in regard to which systematic instruction is given in a number of agricultural schools. It calls for no special comment, except that bee-keeping may be made very profitable as an adjunct to other agricultural industry.

In regard to *aviculture*, it may be said that the instruction is usually very thorough. Avicultural zootechnics, the conditions for the production of various kinds of poultry, their proper classification, their raising and rearing, are often treated with great minuteness. Production for the sake of eggs, for the table, for feathers; the yarding, treatment of diseases, and in regard to parasites, are features of the instruction.[2]

Owing to the fact that the care of streams is part of the professional care of the forester, *pisciculture* is usually a part of the instruction in forestry. It may, however, be referred to by itself. The course usually covers the following ground, viz., the importance of fish as a food; the statistics of the subject, and the present condition of pisciculture throughout the world; the organism of the fish, especially as regards nutrition and reproduction; the more important species, their habits, migration, and classification; natural culture in streams, ponds, and lakes; nature of the bed, temperature of water and its composition; aquatic flora; the creation of fish ponds, spawning beds, ponds for various fish, reserves; causes of the diminishing of fish; restocking; artificial pisciculture—its history, theory, artificial fertilisation, etc.; the various methods of artificial fertilisation, transport of the fertilised spawn; incubation, hatching apparatus, attention to spawn, supply of food-water to the apparatus; ponds for small fry, their feeding and attention required, diseases; diseases and enemies of fish; crayfish, their diseases, restocking; oyster culture, its history, diseases of the oyster; and, lastly, legislation in regard to pisciculture.

10.

[1] For advanced instruction a much higher degree of preparatory education is necessary. The four-year courses in Europe are scientifically on the plane of the ordinary courses in medicine and surgery.

[2] The gallinæ and palmipedes are both exhaustively discussed in the better class of school.

10. *Courses in Agricultural Technology.*—In some institutions quite elaborate courses are given in agricultural technology, and the laboratory equipment for such courses were among the finest features of modern technical instruction seen by the Commissioner.

Among the most important of the subjects treated is the production of *beet-sugar*, which is now more advantageous than that of cane-sugar.

The courses deal with the handling, washing, and transport of the beets, the extraction of the sugar, the use of the residues, the chemical purification, carbonating, electro-dialysis, and the mangano-electric process, the clarification and evaporation of the juice, the clarifying, sulphiting and boiling of the syrup, turbinage, the refining and moulding of the sugar, etc.

The manufacture of *cane sugar* is also taught.

The manufacture of *feculas*, of starches of various kinds, and of dextrine and glucose, the *milling* of grain, the composition of flours, the manufacture of bread, are subjects of instruction in many courses in agricultural technology.

Viticulture is taught in most schools giving anything like complete courses in agriculture, and *œnology* (matters relating to the production of wine, etc.).

In the distillation of *alcohol*, knowledge has advanced very rapidly, and by use of the proper cultures in fermentation the production of alcohols other than ethylic can be limited.

The manufacture of *oils*, viz., olive, nut, colza, sesame, linseed, cotton-seed, coco-nut, etc.; of *perfumes*, from natural and synthetic products; the distillation of attar, neroli, peppermint, geranium, rosemary, thyme, lavender; the *enfleurage* of jasmine, tuberose, violets; the methods of solution in carbon-disulphide, petroleum-ether; the modes of extraction by expressing, and with the ecuelle, of the orange, lemon, citron, bergamot, etc.; the production of turpentine, its essential oil, and colophony, etc., and similar matters, are also subjects of instruction in courses of agricultural technology. So also are the manufacture of *artificial manures*, by the transformation of the waste-products of factories, the preparation of green and degelatinised bone, of phosphate of lime, the production of sodium nitrate and ammonium sulphate, the extraction of potassium salts, the use of dephosphorised wastes, the extraction of phosphates of lime, manufacture of superphosphates, etc.

The production of *textile raw materials*, as the retting of flax and hemp, jute, ramie, etc., are also taught.

Assuming that agriculture is developed in this State in any way commensurately with the needs of the normal population required for the territory, these subjects will have to be included in schools for agricultural instruction.

11. *Technical and Industrial use of Alcohol.*—The Continental practice in respect of the use of alcohol, technically and industrially, is very much more advantageous than our own; it is practically impossible to compete with European industries in which the use of alcohol is necessary, unless pure absolute alcohol, and pure alcohols of any required strength, are at the disposal of manufacturers and technologists. Denatured alcohol is often quite unsuitable for technical use.

12. *Brewing Schools.*—Brewing is no longer an empirical process, and its theory is now taught in a number of schools dealing with agriculture. It is a feature in the Manchester School of Technology and in the University of Birmingham, which latter was created especially to meet the needs of sound instruction in modern science, technology, and commerce.

The composition of barley, malt, hops; the theory of diastase saccharification, the immobilisation of diastase by boiling, the use of pure yeasts, the malting of barley, brewing by decoction and infusion, cooling, pasteurisation, the use of malt, etc., are the subjects dealt with. Besides instruction of this kind, the use of the necessary machinery and apparatus is also treated in the brewing courses.

The preceding references will give a sufficient indication of the kinds of instruction that may be availed of by the European student.

XII.

INSTRUCTION IN FORESTRY.

[G. H. KNIBBS.]

1. *Introductory.*—No country can afford to disregard the subject of forestry, and so one finds that even in countries where there are magnificent and extensive forests, they are by no means neglected, for special schools are created for the proper professional instruction of the foresters to whose care they are committed.

In New South Wales, the forests have been exploited with practically no regard to the conditions which obtain in other lands, where forests are intelligently cared for; and the repair of forests is left mainly to Nature. Natural reafforestation, however, is not sufficient, and unless we secure a proper attention to the matter, the outlook in the future with regard to our timbers is far from reassuring.

It may further be said that timber is cut in this State with little regard to season; the seasoning of timber is generally neglected, and one observes the consequences of this in very many buildings, the Technical College of Sydney itself affording a glaring example of the bad practice referred to.

In order to have an adequate future supply of sound timber for our own requirements, to say nothing of export, it will be necessary to conserve and exploit our forest-lands as is done in other countries, and to place them under proper professional care, that is, under rangers or foresters who have had a thorough scientific and professional training.

2. *References to Courses in Forestry.*—The courses in forestry range between the grade of instruction necessary for those who are charged with the ordinary duties of a mere forest-ranger to those of a professional forester, whose education is of a highly scientific character, and whose calling is essentially a professional one.

In the following schedule some indication is given of the extent to which the subject is treated in the Report; the treatment is by no means adequate, but is sufficient to shew that the subject is a very important one.

COURSES OF INSTRUCTION OF VARIOUS GRADES OF FORESTRY.

Chapters.	Sections.	Pages.	Refers to.
XXXVIII	32	451	Forest physiography at Yale University.
„	45	455	Courses preparatory to Forestry, Yale University.
XXXIX	28	478	Forestry, Royal University of Ireland.
XL	2	519, 520	Forestry at Agricultural High School, Hohenheim.
XLI	4	539, 540	Forestry and Arboriculture at Horticultural School, Wageningen, Holland.
„	6	541, 542	Forestry in the Agricultural High School, Wageningen, Holland.
XLII	5, 6, 8	560	Forestry education in Austria.
„	13	562	Schools for Elementary Forestry in various parts of Austria.
„	23	568	Curriculum in Forestry, Copenhagen, Denmark.
„	30, 36, 37	570–572	The Forestry Schools of Sweden.
XLIII	2, 3	573, 574	Curriculum in the School of Forestry, Zürich, Switzerland.
XLV	13	634–637	Economics of Forestry in the National Agronomic Institute of France.
XLVI	11	650, 651	Course in Forestry, Cornell University, Ithaca, New York State.
„	12, 13	651	Curriculum in Forestry, Cornell University, Ithaca, New York State.

A reference to the passages quoted above will give a sufficient indication of the treatment of the subject.

3.

3. *Higher Courses in Forestry.*—Forestry may form a part of the general instruction in an agricultural course, or may be constituted a course in itself. For example, in the third year in the Agricultural High School of Hohenheim in Germany, no less than three hours per week are devoted to the subject during the whole of the third year of instruction [Chap. XL, sec. 2, p. 520]; in the course on "Forestry in the Netherlands," forestry is itself the main subject-matter [Chap. XLI, sec. 6, p. 542], as in the three and a half years' course in Copenhagen [Chap. XLII, sec. 23, p. 568].

The curriculum of forestry as taught in Copenhagen may serve as an illustration of how the subject is treated. The instruction is given in the Royal Veterinary and Agricultural High School (*Kongelige Veterinær- og Landbohöjskole*), which is very well equipped. From what was seen by the Commissioner during his visit, the work in the school is evidently of the first order of excellence.

The subjects in the curriculum of instruction for foresters (*undervisning for skovbrugers*) are for the first course as follows, viz.:—

Arithmetic and mathematics, including the elements of the differential and integral calculus, mechanical physics and optics, chemical physics, meteorology, inorganic and analytical chemistry, organic and analytical chemistry, theory of soils, etc., botany, the botany of forests specially, introduction to the study of forestry, and during the course there are laboratory practice and demonstrations in physics, chemistry, botany, forest botany, and drawing.

During the second course the subjects treated are:—

Economics, knowledge of merchandise and commerce, the measurement and extent of forests, forestry economics, the theory of their administration, the history and statistics of the subject, land surveying and levelling, vegetable pathology, forest zoology, general economy, farming, forestry, practical forestry, and practical surveying.

The higher forestry courses in Sweden may be divided into three classes, viz.:—(1) fundamental sciences, such as botany, diseases of trees, geology and geognosy, mineralogy, zoology, physics, chemistry, meteorology, climatology, economics, financial science; (2) technical subjects, such as forestry economics, including general forestry, forest-management, afforestation, geodesy and surveying, mathematics as applied to forestry, distribution of forests, agronomy, forestry administration, etc.; and (3) general subjects such as law, political economy, accountancy, etc., as applied to forestry.

The very high character of these courses is obvious. Those who imagine that forestry is a subject for elementary treatment are reminded that the four or five hours a week devoted to mathematics for one and half years in this course includes instruction in the infinitesimal calculus. The very comprehensive, thoroughly professional, and excellently organised character of the instruction generally needs only mention.

4. *The Economics of Forestry.*—The treatment of the subject in the National Agronomical Institute of France is excellent, and will assist the reader in appreciating its scope and utility. The course taken opens with definitions, the elements of forestry economics, preliminary ideas, the general importance of sylviculture, and is then developed as indicated hereunder:—

The relations of the forests to the soil, climate, and needs of man are then treated of in detail as follows:—

Vegetable soil and its geological basis, its formation and various origins.

The influence of the soil on forest-lands, properties which the soils of forests ought to possess, the preponderant rôle of water, study of the various components of the soils and earths from the standpoint of their affinity for water, the nature of the geological foundation, its inclination.

The reciprocal influence of forest-lands on the soil, mechanical, physical, and chemical actions, the formation of humus, its various rôles, conclusions, comparison between agricultural and forest cultivation, especially from the point of view of the soils, the permanence of species, the exigencies of species from the standpoint of the mineralogical composition of the soil, calcareous and non-calcareous soils, indifferent, selected,

selected, and characteristic species, species which select and which avoid lime, the relation between the mineralogical composition of soil and forest distribution, and forest distribution from a geological standpoint.

The relation of forests to climate, general climate, heat at the surface of the earth, chief circumstances which influence its distribution, modifications occasioned by the principal meteorological factors.

The influence of the general climate and of meteorological factors on forest-lands, temperature, humidity, light, electricity, wind, mists, fogs, rain, snow, hail, dew, frosts, climate from a more limited standpoint, local climate, climates of plain, of mountain, of slope, and hill, the influence of the local climate on forest vegetation, the relation between the relief of the ground and forest distribution.

The reciprocal influence of forests on the climates and on meteorological factors, temperature, degree of humidity (absolute and relative), rains (formation and distribution), winds, hail, dew, general distribution of water, springs and water-courses, evaporation, percolation, and flow, a study of evaporation, of infiltration and percolation, and of streams and influence of forests on each of these, accidental circumstances, floods, their principal causes, and the influence of forests on them, torrents in general and their effects, origin and influence of forests.

The relations between forests and human needs, the influence of man on forests, exploitations for the satisfaction of his needs; influence of forests on man, the products they supply to him, the material products of forests, classification, firewood, timber for general use, industry, etc., classification of woods according to density, elementary chemical composition, immediate composition. The structure of woods, elementary tissues or anatomical elements of the annual layer, relations for the same species between the thickness of the annual yield and the density of the wood, or qualities determined by density, the form of the annual growth, medullary canal, pith, medullary spots, sap-wood and heart, the transformation of the sap-wood, the defects and diseases of woods, aspects of trees at different stages of growth, annual consumption of wood. The immaterial products of forests, and the action of forests as it relates to the existence and the health of man, and as to his security.

The course then proceeds to a study of species from the standpoint of the three relations referred to, leafy and resinous species being distinguished.

It then refers to the means of utilising and improving the relations between the forests and soil, climate and human needs, dealing among other things with the following, viz.:—

Forests of tall trees in the state of nature, method of culture, method of taking and planting, mode of clearing, regeneration and improvement, mode of forced culture in special circumstances, mode of thinning, mode of culture, felling, dressing, and removal in tall forests. Copse, two modes of treating, simple copse and undergrowth in tall forests, special features of the former, copse-undergrowth, felling, dressing, and clearing copse, copse of various kinds, copse under tall forest-trees, staddling, reserves, intensity of thicket, artificial restocking, clearing, pruning, lopping, etc.

Artificial reafforestation, seed-plots, the collection and conservation of seed, its qualities, preparation of the ground, weeding, burning, etc., season, quantity of seed, seed-plots, transplantation, seeds of various trees. Plantations, generalities, plants taken from the forest, nurseries, and site for same, the cultivation of plants in a nursery, maintenance, improvement of plants, their removal, planting a property, proper season, making the holes, spacing the plants, setting, maintenance of seed-plots and plantations, species and mode of selection for restocking, cuttings, layers, the influence of humidity on the success of artificial reafforestation, and on the existence of forests generally.

In forming estimates of wood, the mode of finding the contents of the trunk, and of the upper part viz., the great branches and twigs of trees of large dimensions is explained, and as regards the sale of wood the course treats of wood for general purposes, timbers, railway-sleepers, telegraphic posts, mine props, etc., the measuring, cubature, and sale of round and square timber, of ship timber, of timbers for industries, manufactures, etc., of various other timbers, firewood-blocks, round logs, small timber, fagots, brushwood factors of transformation applicable to firewood, yields in wood-work and in firewood of trees that may be cultivated in the copse and in the tall forests.

The carriage of timber is discussed somewhat fully, viz., by direct labour, by beasts of burden, by streams, rafts, etc., over various classes of roads, in railways, and canals, etc., the cost per kilometre being determined, the cost of maintenance of roads per kilometre, of carriage per ton, per kilometre. Initial carriage, unloading, *i.e.*, secondary carriage, the concentration of products, carriage to market.

The money value of fallen timber is determined as respects net value, as wood for industries, and as firewood.

The question of the conservation of timber deals with fallen timber, firewood, and, as regards lumber, treats of natural processes, aeration, immersion, artificial processes, coating, and injection.

The choice and application of method of treatment of forests in the best interests of the proprietors, *i.e.*, the management of forests, is discussed in relation to the object to be attained, the problems to be solved, successive operations, statistics and the possibilities of exploitation with reference to products, with reference to régime and mode of treatment, and with reference to the position of the proprietor to the State, individual, and commune.

In connection with the estimation of value and quantity of timber in forests, the commercial value of the capital, the nature of the value of forest property, its possible transformation, its value estimated on the basis of its stock of timber and area, and the principles on which the rational estimation of a forest rests, are thoroughly treated. So, also, are the questions of the preservation of timber in its actual condition, the transformations or modifications of a forest, the method desirable in the case of forests of high trees, and the necessary formulæ for the calculations and estimation of the wood, are included in the instruction under the head of political economy as it relates to forestry questions are discussed, the difficulties met with in the science of forestry, the dangers which threaten forests, circumstances which oppose

oppose the development of forestry, and which modify it. Under this last are included general circumstances affecting the relations of forests of all kinds to the requirements of the agricultural and pastoral industries, the competition with coal, iron, foreign woods, and finally the insufficiency or imperfection of the means of transport, from the point of view of forestry itself, and particular causes, inherent in forests of each kind, and variable according to the position of the proprietor. The whole question is dealt with from the individual, communal, and State standpoint, and refers to forests belonging to individuals, to communes and public bodies, and to the State.

It may be mentioned that the special course in forestry is very thorough in all European countries. Reference may be made to the Report [Chap. XLIII, sec. 3, pp. 573, 574] for an outline of the three-year course in Zürich, Switzerland.

5. *Lower Courses in Forestry.*—As an illustration of the lower types of courses in forestry, that of the lower forestry schools of Sweden may be taken. These are intended for the education of forest-rangers.

The theoretical and technical work consists of forestry economics, botany, zoology, mathematics, cartography, writing, accountancy, gamekeeping and game preservation, the management of forests, and regulations as to their supervision.

The practical work consists of forest and field-surveying, sylviculture, the thinning and exploitation of forests.

6. *Concluding Observations on Forestry.*—The importance of the subject of forestry generally, and to our State in particular, might seem too obvious to need mention, were it not for the fact that the exploitation of our forests is often spoliation, and there is, from the continental point of view, no adequate regard for our future. Reckless devastation of their magnificent forests was characteristic of America, but already the necessity of systematic attention to the matter is impressing itself on the authorities of the United States. And no one familiar with New South Wales, and with any regard for its future, can view the situation as it stands with unconcern.

It would be well if some provision were made for systematic instruction in the subject, as well as for more thorough and efficient organisation of the forestry department, the importance of which is publicly wholly underestimated.

The wealth in timber of New South Wales will be a rapidly diminishing quantity unless reafforestation is systematically undertaken and protected by suitable forestry management and police.

XIII.

CONCLUSIONS REGARDING AGRICULTURAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—In connection with agricultural education, the real questions for settlement are:—(1) Is agricultural production of sufficient moment to warrant expenditure on agricultural education? (2) What education would be adequate? (3) Is our existing scheme for such education satisfactory? (4) If not, what is requisite.

It may be postulated that the consensus of intelligent opinion in every country—the progress of which justifies a reliance thereon—is that the State must concern itself, *qua* State, with the efficient education of its citizens.

It may be mentioned that one country, whose recent progress is very remarkable—Japan—has seen fit to very thoroughly organise agricultural education for her relatively limited territory. Besides the preparatory and main courses established at the Sapporo Agricultural School in that country, there are courses in agriculture, civil engineering, and forestry. The main course is four years, and the others three each. The former is higher instruction, the latter secondary. The establishment of the school was in response to an incisive examination of the whole question of the necessity for such instruction.

2. *The Necessity for Agricultural Education.*—If it could be shewn that Agricultural Education would benefit Agriculture—one of our great primary industries—in such a way that the consequent increase of wealth to the people of the State would far surpass the expenditure involved, then, it is presumed, the State would promote it, even if taxation were necessary to find the means. For the people who would directly benefit, and those who would indirectly participate therein, would receive more than they would lose, and there is no hardship in having to contribute a small portion of increased wealth for the maintenance of the condition on which it depends.

Again, it is clear that successful agriculture will tend to increase the population, *a matter of pressing urgency* in every sparsely-populated country, and particularly in Australia, as will be shewn hereinafter.

3. *Review of the Importance of Agricultural Instruction.*—In determining how far it would be wise to push the effort to provide agricultural instruction, it is evident that the measure of its importance must be taken into consideration. This question may be grasped by observing:—

(1) That it is indubitable that modern improved methods of agriculture greatly increase the yields, so that the expenditure involved therein is made good many times over;

(2) That the scientific method enables the agriculturist to definitely ascertain whether and what fertilising agents are required, and in what amounts;

(3) That increased yields mean that the payable area for any particular type of cultivation may be much enlarged;

(4) That various crops which at present are not profitably grown may become profitable through better agriculture;

(5) That scientific method is essential in endeavouring to cope with local agricultural problems.[1]

Regarding (1) above, the total value of the crops for 1904 was £8,359,000, of which wheat alone represented £3,975,000. Hence, if through agricultural instruction the yield were increased only 10 per cent., the increase of wealth would be £835,900, or on wheat alone, £397,500. It is in the light of a fact like this that the value of such research as Mr. Farrer's on the improvements of wheats can be appreciated, and that the economic side of agricultural education can be justly gauged.

Belgium is an agricultural country, and it has been incontestably shewn there, and in the most striking manner, that the old methods cannot compete with the new; that the expenditure in improved methods of agriculture and in fertilisers pays, provided it is scientifically and intelligently directed. The experience of the whole of Europe confirms this.

Respecting (2), we can hardly be regarded as having, so far, considered the question of the use of artificial manures on any large scale, or in any systematic way. Agricultural instruction, worthy of the name, would enable a farmer to definitely discuss the economic side of the problems of cultivating any area for particular crops, and to decide beforehand whether to employ certain methods, or certain fertilising agents, will pay or not.

With regard to (3), it may be noted that in 1904 no less than 2,543,000 acres were under crops, the average value per acre being £3 5s. 9d. If, therefore, the area could be increased, as a consequence of proving that wisely-directed agriculture will pay, and that what is required is merely that it should be undertaken only by properly-instructed farmers, then the State's wealth would be correspondingly augmented. A 10 per cent. increase of production, and a similar increase of area under cultivation, is surely not an extravagant estimate of the probable result of better knowledge, and we have seen that this represents over £1,500,000 per annum. Hence, whatever portion of this stands to the credit balance, after deducting the cost of improved methods, represents what might with advantage be spent on agricultural education. It is immediately obvious that to fail to advance a type of education which is of so much promise would be worse than a false economy.

4. *Agricultural Education as a factor in increasing the density of Population.*—There is a still more serious aspect of the question. Any attempt to increase the density of the population of the State and Commonwealth must be largely dependent upon the development of our primary industries, among which agriculture occupies an important place. The mere handful of people occupying this territory at the present time cannot create the necessary material wealth for its successful permanent occupation and defence, hence the existing condition is one of jeopardy. If the creation of a University, and of higher schools, for the express purpose of reinforcing the intelligence of a nation, humbled and ruined by war, was the right remedy for the terrible evils which had befallen it—as was the case with Prussia—a similar policy may be expected to result in a similar development and in similar results here. We do not yet realise here that it is *good—i.e., suitable—education which we want above all things.*

The following table will shew to what a slight extent our territory is populated in comparison with Europe, the greater part of which could lie well within the outline of the continent.

The table will shew also how densely populated are several countries within a very small distance of Australia. [See countries shewn in clarendon type.]

Excluding Russia, the area of the whole of Europe is short of 1,700,000 square miles, while Australia is no less than 2,900,000 square miles.

Relative

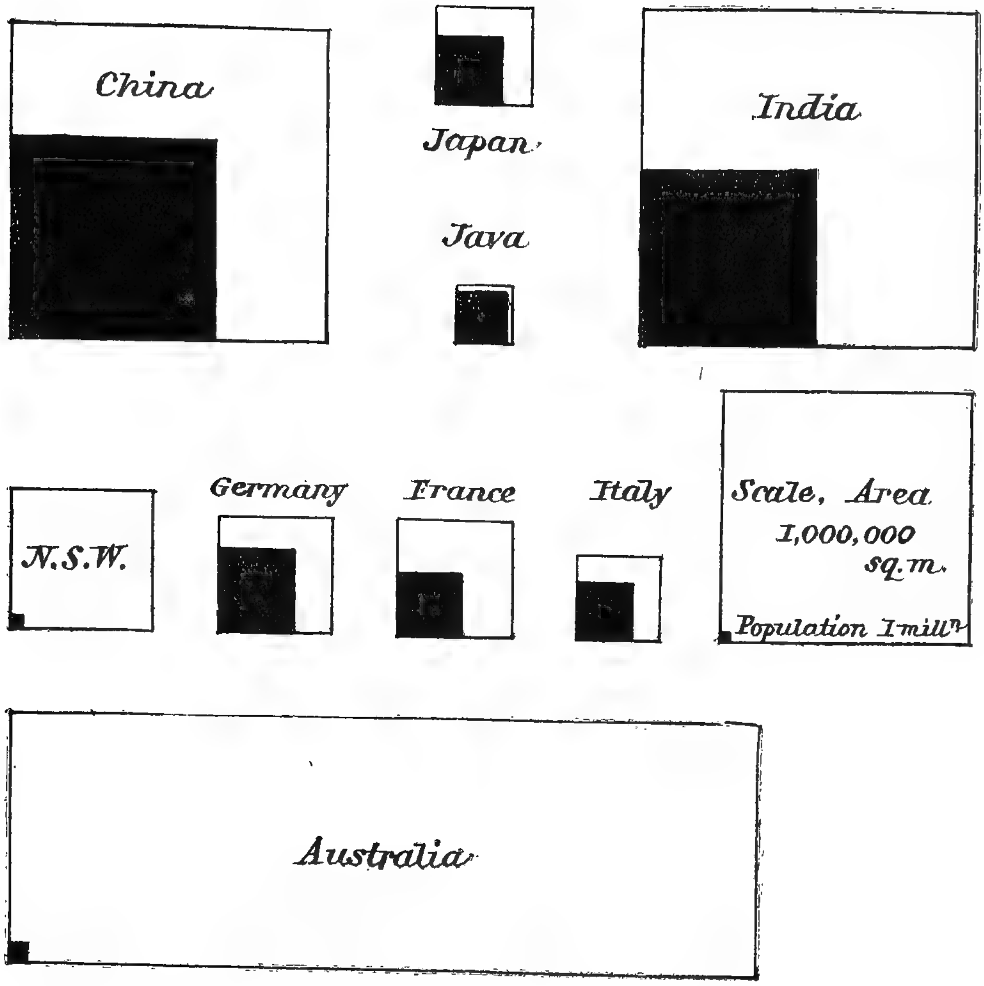
[1] The development of a rust-proof variety of wheat is an illustration of what is meant. It may be further noticed that the milling qualities must also be taken into consideration.

Relative Sizes of Australia and European Countries.

DENSITY OF POPULATION.

Country.	Area in 1,000 square miles.	Population in thousands.	No. of human beings per square mile.
Belgium	11·4	6,985	613
Java	**50**	**29,000**	**580**
England and Wales	58·5	33,763	577
Holland	12·6	5,431	431
Japan	**147**	**47,000**	**319**
Italy	111	33,000	297
Germany	208	56,000	269
China (proper)	**1,532**	**407,000**	**265**
Switzerland	15·9	3,325	209
France	207	3,900	188
Denmark	14	2,464	176
India	**1,766**	**294,000**	**166**
Portugal	34·6	5,423	157
Scotland	30·4	4,627	152
Ireland	32·5	4,398	135
Servia	19	2,579	135
Roumania	50 2	5,956	118
Austria	241	26,150	108
Greece	25·3	2,645	104
Spain	193	18,831	97
Bulgaria	38 3	3,744	97
Turkey	63·3	6,130	97
Montenegro	3·6	228	63
New South Wales	**311**	**1,500**	**4·8**
Australia	**2,973**	**3,800**	**1·3**

The above results are well understood in other parts of the world. They shew that *Australia is relatively an uninhabited country*, a profoundly significant fact. This is illustrated in the following diagrams :—



Diagrams Shewing Relative Areas and Populations of Australia, New South Wales, and Several Other Countries.

In the diagrams the surfaces of the rectangles, including the dark squares, shew the relative areas; the surfaces of the dark squares themselves shew the relative populations.

A relatively uninhabited country, in close proximity to densely populated countries, has clearly an easily recognised problem before it, which need not be further referred to, except by way of observing that any tendency to stagnation in the way of development of industrial activity, or in the way of increase of population, intensifies the problem. When it is remembered that the right to hold a country is practically limited by the power to make use of it, it will be seen that *all forms of education which strengthen our industrial power are of the first order of importance.*

Among these, agriculture must take a prominent place: if the State is to develope, the ability of its people to exploit its natural resources must be vastly increased.

5. *The Spirit which will help Agricultural Education.*—A farmer who used 10s. worth of a fertilising agent where he should have used £10 to secure success, would be justly held to have deserved to meet with failure, and, similarly, an administration which hesitated to provide the necessary amount and kind of *education*—the word is used in its widest sense—to command success, could hardly complain if education failed to reach its normal results. Apparent economy is not always real economy, and in the judgment of the Commissioner here writing, we are not spending enough on education.[1] The

[1] We are spending less than any similarly sparsely-populated country making any pretence to educating its people, less, for example, than the Argentine Republic. We are also spending less even than some of the densely-populated parts of Europe, per pupil, or per inhabitant.

The researches, by which beet sugar was enabled to displace cane-sugar, were very costly, regarded in themselves, but they were not uneconomical in the end—quite the reverse. Such experiments as have been carried out by Mr. Farrer of this State, in the production of a rust-proof wheat, might also seem costly to a mere routine administrator, who regarded economy of administration as the "be-all and end-all" of his office and estimated it by smallness of outlay. But it would be difficult, in fact quite impossible, to ascertain how many hundred of thousands, or even millions of pounds, sterling such researches are actually worth. Economy must be discriminating, that is it must be subordinated to the question of efficiency.

The same remark applies to Berthelot's researches in agriculture in France.[1] One of the great advantages which Europe has over our State lies in the radical difference of attitude to scientific knowledge, scientific discovery and research, and to higher scientific training. In Europe every teacher, during his professional training for his office, learns something about science in the proper way, *i.e.*, experimentally. The scheme of professional training makes him competent to teach. Hence the *popular attitude toward science*, which is the consequence of this, is sympathetic and intelligent. The right foundation for after-education is laid in the primary school. And each grade of teacher is powerfully influenced by the men of better education above him, and hence the mental attitude is determined, and the scientific instinct is awakened, by the higher class of teachers infusing their views into the lower. The educational work of the State will not succeed for agriculture, or for anything else, until we have a more excellent system in the primary school, and through this we fundamentally change the popular knowledge of, and attitude toward, science.

6. *Conclusions.*—If agricultural education is to be a complete success, it will be necessary to provide for instruction of the highest, secondary, and elementary grades, and to suitably orientate the teaching of science in a large number of the primary schools. These several things are necessary, and there is every reason to believe that the considerable expense involved would be abundantly repaid by an increase of agricultural production, compared with which the cost would fade into insignificance.

In the way of positive recommendations the following are submitted:—

(1) Agricultural education of the first grade—*i.e.*, of the University type—should be provided for the education of instructors in agricultural subjects, for the highest class of agriculturists, and for managers of large agricultural estates. This course would be, say, of from three to four years. The preparation ought to be a secondary school education, with instruction in science. A forestry course is also desirable, of the same grade.

(2) The multiplication of secondary agricultural schools, well staffed, with areas of a more moderate size than that of the Hawkesbury Agricultural College, is also essential. The members of the staff of these should have passed through agricultural schools of the higher type, viz. (1), or should be specialists in their particular department, of good scientific education, and with the necessary practical experience of the application of their specialty to agriculture. The *main courses* in these schools should be of two years' duration. A forestry course of a secondary character is also desirable. The preparation for the secondary agricultural school, proper, should also be a secondary school education with science teaching.

(3) Elementary agricultural schools with a 1-year course for ordinary farmers, demanding only the preparation of a primary school course with elementary science teaching.

[1] Carl Snyder, in his "New Conceptions in Science," London, 1903, refers to a scientist in these terms:—"Pasteur, who . . . . . added millions to the wealth of his beloved France" (p. 30); and in his chapter on "*America's inferior position in the scientific world,*" he says that Pasteur's work is estimated to have saved France alone more than the cost of the war with Germany, with the indemnity thrown in (p. 334). Of Berthelot he says, that "the list of his discoveries, the range of his work, the fertility of his resources, have been amazing" (pp. 314–5), and in other places he points out the great value of Berthelot's work.

(4) Special schools, forming sections of secondary (2) or elementary (3) agricultural schools for special courses, as for dairying, etc., and also for lower forestry.

(5) Special attention should be paid in these schools to methods of farming under the limitations which ordinarily obtain.

(6) Short courses for farmers, with practical working of newer methods, by scientific and practical experts whose reputation and skill must command respect.

(7) Lecture courses for farmers on modern agriculture generally, and on new developments of agricultural knowledge or on scientific discoveries affecting agriculture.

(8) The orientation of nature-study and of elementary science in country schools, so as to shew the relationship of science to agriculture, and to create an instinct of appreciation of what science can do for agriculture.

(9) Special science-teaching might well be introduced into the primary schools by science teachers working under the Director-General of Technical Education, *i.e.*, the officer in charge of technical education in the State.

The following general observations are necessary in explanation of the preceding recommendations.

(10) Concerning (1), it will be desirable to ask the University to abandon the demand that *all* matriculates shall pass in the Latin language.

(11) Contingent upon the abandonment of Latin as a compulsory subject for matriculation, provision could be made *within* the University for agricultural instruction. This would have many advantages.

(12) If the University maintain its present attitude to the Latin question—an attitude which has now been abandoned by nearly the whole of the Universities of the world—it is desirable that provision should be made *outside* the University for the highest grade of agricultural instruction. This is imperative since it is undesirable that the doors of the institution giving the highest form of agricultural instruction should be closed[1] against students who prefer to study French and German, or Italian, or any of these languages to Latin. The reason for this is that the modern languages, being the repository of so large an amount of useful professional and scientific information, rank in the first grade of importance in science generally and in agriculture.[2]

(13) If agriculture is to be taught in the University, the teaching of physics, chemistry, geology, zoology, botany, and biology ought to be specially orientated with regard to agriculture, for the students who take up agriculture.

(14) *Chemistry* as at present taught would not meet the normal requirements of a student of agriculture, and further provision would be necessary in the department of chemistry.

(15) The teaching of *Botany* would have to be considerably advanced; and it would be necessary to treat it as a special subject and in relation to agriculture for agricultural students.

(16) The agricultural instruction should be organised either (*a*) by a professor of agriculture who has passed through and who holds the full-course diploma of a Continental high school of agriculture—since the excellence of these is unexcelled—or (*b*) by some person eminent in *scientific knowledge and scientific training*, and possessed of the necessary linguistic acquirements, sent to specially study European methods of agricultural instruction at Berlin, Hohenheim, Gembloux, and Paris, and similar institutions.

(17)

---

1 Non-matriculated students can attend lectures, but they are not entitled to the full privileges of the University, and receive only certificates; they cannot graduate. Relatively few persons care to attend a University under the conditions.

2 The reading of German works on agriculture is part of some of the American courses.

(17) Finally it may be said that if the University can be persuaded to follow on the line of the recent world-wide movement for the abandonment of *compulsory* Latin in the case of those who wish to study science, engineering, agriculture, chemical technology, mining, metallurgy, architecture, modern literature, commerce, etc., it would then be better that it should be the home of all higher educational effort, and hence, under such conditions, agriculture might well be taught therein.

(18) Seeing that nearly all the Universities of the world, even including most of those in the United Kingdom, do not insist on Latin for matriculation for *every* subject, as does the Sydney University, and that this insistence will greatly prejudice the extent to which the institution will be utilised, representations should be made to its authorities on the matter, pointing out the advantages which would accrue to the people of New South Wales by its falling into line with the practice of nearly the whole of the Universities of the world, viz., the abandonment of an insistence on Latin for all matriculates.[1]

(19) The qualifications which should be insisted on in the case of a professor of agriculture are indicated in VII, § 7, hereinbefore.

(20) It is very important that scientific research in agriculture[2] should be maintained.

(21) The *Agricultural Gazette* should be continued as an informative publication, directly under the scientific experts of the Department of Agriculture.

---

[1] At present the attitude of the University debars many a student who, under conditions which obtain throughout, it is believed, *all* the Universities of Europe and nearly all the Universities of England, Ireland, Scotland, and America, would be glad to enter upon its courses. This question is a very serious one, and if the University is to benefit the country to the fullest possible extent, its conservatism must assuredly be abandoned.

[2] Such for example as that undertaken by Messrs. Guthrie and Farrer, and by Dr. Cobb, of the Department of Agriculture. Experiments made by Mr. H. Lord, the Lecturer in Agriculture at the Central Technical College, Sydney, shewed that the effect of manuring was to increase a potato crop to 240 per cent. The *net* increase of the value of the crop was over 100 per cent.

XIV.

XIV.

COMMERCIAL EDUCATION GENERALLY.

[G. H. KNIBBS.

1. *Introduction.*—The idea of a special type of school for training business men is by no means new, for as far back as 1717, a Thomas Watts wrote a pamphlet of 50 pages on "The Proper Method for Forming the Man of Business," and founded a school to qualify for any type of business "after a new, expeditious, and improved manner of instruction, free from the interruptions and loss of time in the common schools." In this, the general importance of education, the necessity for its adaptation to different minds, penmanship, arithmetic, accounts, the double-entry or Italian method of book-keeping, mathematics including geometry, surveying and measuring, commercial law, navigation, geography, English style, modern languages, and drawing were all treated from the point of view of the practical value and use in training for a business career.[1]

England, we thus see, was early in the field with a scheme for systematic commercial education, but the effort was private, and did not lead to any general attempt to establish commercial schools worthy of the name.

Even to-day the whole provision for commercial education is by no means of a satisfactory order. Although the Royal Commission of 1884 on Technical Education stated that "in this matter of education we seem particularly deficient as compared with some of our foreign competitors; and this remark applies not only to what is usually called technical education, but *to ordinary commercial education which is required in mercantile houses, and especially in the knowledge of foreign languages,*" and although a considerable advance has been made, there are not yet in England commercial schools with the perfect organisation of those in various parts of Europe.

2. *Recognition of need for Commercial Education in New South Wales.*—Recent activity on the part of the Chamber of Commerce, and recent correspondence in the Sydney Press, shew that it is beginning to be understood that we have no systematised scheme of commercial education in New South Wales. Although the commercial colleges, established privately, have been created to meet an important demand for instruction in commercial subjects, and have endeavoured to supply a want, which the State system did not supply, they are not commercial schools of the European type. If the curricula of the commercial schools of Europe—referred to hereinafter—be examined, the impartial reader will at once recognise that they are thoroughly organised; and, in the strict and definite sense, provide commercial education, as is evident from the curriculum even of the early commercial school of Budapest, 1857–8. [Chapter LVIII, section 2, page 793.]

3. *What constitutes Commercial Education.*—Recently it has been thought that if the University of Sydney were to *hold examinations* to test the knowledge of candidates, it would force the various schools to provide suitable commercial instruction. This system of determining the quality of education in the State is quite characteristic. As it fundamentally affects educational method, it should be looked at very closely. The

---

[1] They have undoubtedly therefore done useful work under the conditions which have prevailed.

The examination system of proving qualification labours from the defect that it is largely a test of *memory*, and of the capacity to "cram," rather than of *faculty* and good teaching. For this reason continental educationists believe that in order to establish any particular form of education, it is necessary to do three things, viz., (1) to organise a curriculum; (2) to provide a suitably equipped school; and (3) to staff it with thoroughly qualified teachers for the particular type of instruction intended to be given.

No one can examine the two ideas—viz., (*a*) that some authoritative outside body should hold examinations, or (*b*) that a properly equipped and staffed school should be founded—and hesitate in his decision as to which is the efficient method.

The method (*a*) lends itself to what may be called educational charlatanism, and is held in well-deserved contempt by eminent educationists; the method (*b*) may be more expensive, but it bears sound educational fruit. The cause of good is *not* promoted by inducing schools to vary their teaching to meet examination requirements, where "cramming" must be an essential feature; that cause is promoted by founding properly constituted schools whose function it is to supply a *thorough education* of the particular type required.

It is desirable that the question, here referred to, be faced fairly, because self-deception will injure no one but ourselves, and it will blind us to a fact with which our national destiny must be closely connected, viz., the efficiency of an educational system.

We may say definitely, therefore, that the mere holding of examinations by the University, for example, of junior and senior grade, for determining the qualifications of candidates who present themselves in so-called commercial subjects, is not to be confounded with the establishment of a sound system of commercial education: this will be clear to any reader of the report. The proposal to hold examinations, in lieu of providing good teaching, is educationally indefensible: it cannot be justly regarded as worthy to be regarded as a serious attempt at improving our educational system.

4. *References to Commercial Education in previous Reports.*—The following references to commercial education by the Commissioner here writing will be found in the Interim Report mainly on Primary Education, and in the Report on Secondary Education:—

REFERENCES TO COMMERCIAL EDUCATION IN INTERIM REPORT.

Chapters.	Sections.	Pages.	Refers to—
V	3	33	Commercial arithmetic, book-keeping, etc.
"	4	36	Place of Commerce in the Educational Scheme of the Canton of Geneva.
"	9	49	Commercial education in the Canton of Vaud.
VI	27	66	Place of Commercial Schools in the German system.
VII	8	82	The Commercial Schools of Russia.

REFERENCES IN SECONDARY EDUCATION REPORT TO COMMERCIAL EDUCATION.

Chapters.	Sections.	Pages.	Refers to—
II	8	6	References to Commercial Education and its place in a system.
XI	19	135	Commercial and industrial divisions in the Belgian Athenæums.
"	19	136	Commercial Science in the Belgian Athenæums.
XXIV	12	290	Political Economy, Commercial law, book-keeping, etc., at Utrecht.
XXV	2	299	Commercial section in the Italian Technical Institute.
XXVI	5	310	Commercial division of a Russian Real School.
"	6	311	Curriculum, Russian School of Commerce (of seven classes).
XXVII	3	316	Place of Commercial Schools in Zürich system.
"	28	331	Mercantile division in Cantonal School of Appenzell, Est.
XXXI	4, 5	365-6	Commercial Schools and Museum of Japan.

The

The preceding references give an account of commercial education sufficient to show what constitutes an organised scheme, a very different thing to teaching a little book-keeping, shorthand, typewriting, etc., in an ordinary primary, or higher primary school. To introduce a few commercial subjects is not the same thing as to organise a scheme of commercial education.

As a recent instance of a vigorous belief in the value of commercial education the building of the Higher School of Commerce at Tokyo alone at a cost of £73,500 may be mentioned.

5. *References to Commercial Education in the present Report.*—The following references to various features of commercial education are to be found in the present Report:—

REFERENCES TO COMMERCIAL EDUCATION.

Chapters.	Sections.	Pages.	Refers to—
LI	1–5	723–7	The curriculum, etc., of the Faculty of Commerce, University of Birmingham: Bachelors of Commerce, etc.
,,	6–9	727–731	Curriculum and courses of the Faculty of Commerce University in Manchester.
,,	9	731	Commercial courses in the University of Liverpool.
,,	10	731–2	Scheme of Commercial Examinations instituted by the London Chamber of Commerce.
,,	11	732–3	The Junior Commercial Certificate, London.
,,	12	733	The Senior ,, ,, ,,
,,	13–16	733–7	Teachers diplomas, curriculum, etc., in Commerce, London.
,,	17	737–8	Lectures on miscellaneous matters connected with Commercial Education.
LIII	1–37	741–750	The Higher Institute of Commerce, Antwerp, its curriculum and regulations.
LIV	1–4	751–2	Commercial courses and schools in Austria.
,,	5–6	752–3	Commercial Academy of Aussig in Bohemia, its curricula.
,,	7	753	Mercantile School of ,, ,, ,,
,,	8–9	754–5	Commercial Academy of Olmütz.
,,	10–18	755–7	Commercial Education in France and Germany.
LV	1–37	758–774	Complete scheme of the Higher School of Commerce of Lille, France, including its extended curriculum.
LVI	1–34	775–785	Complete scheme of the Higher School of Commerce of Marseilles, France.
LVIII	1–35	793–807	Outline of the whole scheme of Commercial Education in Hungary, referring to all classes of schools.
LIX	2	808	Programme of the Commercial Institute of Helsingfors, Finland.
,,	3, 4	808–9	Commercial Schools of Holland.
,,	5–10	809–11	Various forms of Commercial Education in Italy.
,,	11	812–4	Curricula of the Royal Higher School of Commerce of Venice.
,,	12	814	Commercial Education in Norway.
,,	13–15	814–5	Various forms of Commercial Education in Sweden.
,,	17–18	815–7	Organisation of Commercial Education in Russia, and programmes of two schools.
LX	2–5	818–20	Commercial Education for young women in Berne, Switzerland, and curricula.
,,	6–8	820–2	Commercial School in the Municipal Gymnasium of Berne, and its complete curriculum.
,,	9–18	823–8	Genevese Commercial Education, curricula, etc.
,,	19	828–831	Organisation of Commercial Education at the Cantonal School of Lausanne.
,,	20, 4	831	The Commercial School at the Technicum of Winterthen, and its curriculum.

There are also other references to commercial education, viz., by Mr. J. W. Turner, for example the courses at Neuchatel, in America, etc., which countries have consequently not been referred to, though their systems were studied by the Commissioner here writing.

A monograph of considerable value on Commercial Education in the United States may be found in Vol. II of the Special Reports on Educational Subjects, Part 2, by Mr. P. J. Hartog, of the Victoria University, pp. 229–298, with a series of valuable Appendices, pp. 299–417.[1]

6.

[1] London, 1902.

3—o

6. *Brief Bibliography of Recent Works on Commercial Education.*—Since, so far as can be judged from Press discussions, the continental conceptions, and the trend of modern commercial education appear to be as yet somewhat unfamiliar, the following short and very imperfect bibliography of recent works and monographs on commercial education is given, to assist the study of the question:—

BIBLIOGRAPHY OF THE LITERATURE OF COMMERCIAL EDUCATION.

Doggett, W. E.	Commercial High School Course. Nat. Educ. Assoc. Proc.		1900
Kahn, A.	Commercial Education in Secondary Schools. "Lond. Educ. Times"	May,	1900
Scott, W. A	Technical Education of Business Men. "Railroad Gazette"	Oct.,	1900
Wisconsin University	Establishment of a School or College of Commerce		1900
Crissy, I. O.	Curriculum of Ideal Commercial School. "Western Penman"	April,	1901
Fitch, Sir Joshua	School Work in relation to Business. Journ. Soc. Arts	May,	1901
Hooper and Graham	Commercial Education at Home and Abroad		1901
Johnson, J. B.	Higher Commercial Education in America. "Western Penman"	April,	1901
Ware, Fabian	Educational Foundation of Trade and Industry		1901
Whitfield, E. E.	Commercial Education in Theory and Practice		1901
Anderson, J. M.	Training for Business. Nat. Educ. Assoc. Proc.		1902
Ashley, W. J.	Purpose and Programme of the Faculty of Commerce, Birmingham University		1902
Baker, James	Technical and Commercial Education in East Prussia, Poland, Galatia, Silesia, Bohemia. Special Repts. II		1902
De Garmo, Charles	Conscience and Commercial Education. "Practical Age," Moline, Ill.		1902
Ellis, Carlos B.	Commercial Education in Secondary Schools. "Education"	July,	1902
Europe	State of Commercial Education in. "Education"	April,	1902
Ferris, W. N.	True Commercial Education. "Penman, Artist, etc."	April,	1902
Hartog, P. J.	Commercial Education in the United States. Special Repts., II.		1902
Haskins, C. W.	Business Training. En. Com. Teachers' Assoc. New York		1902
Heinig, A.	Commercial Education in Germany and England. "School Review"	Feb.,	1902
Hooper, G. N.	Education preparatory to Commercial Pursuits		1902
Irish, C. W.	Place of Commercial Studies in the High Schools. "School Review"	Sept.,	1902
Laughlin, J. L.	Higher Commercial Education. "Atlantic Monthly"	May,	1902
Lyons, J. A.	Pædagogy of Commercial Branches. Chicago		1902
Michigan Alumnus	Symposium on Higher Commercial Education		1902
Montgomery, J.	Commercial Education in Germany. York Assoc. Rept.		1902
Sadler, M. E.	Recent Developments in Higher Commercial Education in Germany. Special Repts., 9		1902
Sano Zensaku	Commercial Education in Japan. Spec. Repts., 8		1902
Schoch, Parke	Intent and Scope of Commercial Education in the Business College and the Secondary School. New York		1902
Stephens, E. L.	An Address on Business Education. New York		1902
Yoxall, J. H.	Difficulties in Educating for Business. "Mag. of Commerce"	Dec.,	1902
Ashley, W. J.	The Universities and Commercial Education. "N. Amer. Rev."	Jan.,	1903
Barber, E. M.	A Contribution to the History of Commercial Education. "Bus. Educator"	May,	1903
Commerce and the Universities.	"Mag. of Commerce"	May,	1903
Commercial Education	Quarterly Record of. Indianopolis, Ind.	Jan.,	1903
Education and Business	"School Review"	Sept.,	1903
Ellis, Carlos B.	Purpose of good Business Dept. in a Public High School. "School Review"	Feb.,	1903
Gaines, C. C.	Training needed for Success in Business. "Bus. World"	Aug.,	1903
Harris, E. L.	Primary Commercial Education in Germany. U.S. Con. Rept.	June,	1903
Haskins, C. W.	Mem. Edit. Essay on Accountancy and Business Education		1903
Kaufmännische Bildungswesen aller Länder.	"Revue über," Leipzig		1903
Luman, J. A.	Business Education and the Proprietary School. "Bus. World."	Aug.,	1903
Wisconsin University	Bulletin on School of Commerce	May,	1903
Michigan Pol. Sci. Assoc.	Higher Commercial Education		1903
Commerce, Lectures on	University of Chicago		1904
Fayant, F. M.	Commercial Education in England. "Bookkeeper"	Mar.,	1904
Harris, E. L.	Commercial and Industrial Education in England. "U.S. Cons. Rept."	Jan.,	1904
Herrick, C. A.	Meaning and Practice of Commercial Education. Mass.		1904
Yorkshire	County Council of the West Riding of. Commercial Education in the Technical and Evening Schools		1904

The above bibliography will give some idea of the considerable literature in English alone on commercial education.

7.

7. *Grades of Commercial Education.*—Commercial education is found in various classes of school, and is of various grades, the highest and most specialised form being given in what may be called a Commercial High School or University, or in an ordinary University with a specially organised commercial department; and the lowest and least specialised, that to be found in the elementary school. Touching the latter, it may be said that such elements of primary instruction as are orientated with reference to commercial life and pursuits—such parts of arithmetic as are specially designed to illustrate calculations required in commerce, such features of geography as throw light upon ways of communication upon the great trading routes, the products of countries, the peculiarities of their commerce, and so on, constitute, in a very real and accurate sense, commercial education.

The various types of commercial schools may be set forth in descending order, as follows :—

(1) Commercial High Schools of the first grade.
(2) Commercial sections, faculties, or courses in Universities.
(3) Secondary Commercial Schools.
(4) Commercial sections or departments in Secondary Schools.
(5) Evening Commercial Schools of Secondary grade.
(6) Elementary Commercial Schools.
(7) Evening Schools for Elementary Commercial education.
(8) Courses in Commercial subjects in various classes of schools.

Besides this, the instruction in any class of school may be orientated with special reference to commerce, as to other subjects. The above statement, though by no means exhaustive as regards the scheme of commercial education, gives a sufficient illustration of its variety of organisation: details will be given in later divisions of this report. As may be readily understood, each grade of instruction shows in different countries some difference of scheme and general arrangement, and the demands as to necessary entrance preparation are very various.

8. *The Equipment of Commercial Schools.*—Genuine commercial schools must possess a suitable equipment for instruction, and in the secondary, and higher grades of school the necessary chemical, physical, and technological apparatus, besides the material to illustrate the arrangement of a business house, the museum to familiarise the student with various forms of merchandise, and the plant for testing their quality.

The thoroughness of the equipment of most of the commercial schools in Europe is remarkable. Not only is the apparatus to hand for making the teaching intuitive and thoroughly practical—especially as regards the actual features and details of a business house—but the museums are well organised and supplied, the apparatus for demonstrating the physics and chemistry of the subject, all that could be desired. In many cases the museum material specially illustrates what is produced in important local industries, and liberal donations are made by local manufacturers.

The information as to the products, and the industrial development of various countries, is often very complete. The obtaining of this information is evidently perfectly systematised, and the subject of commercial geography has attained to a thoroughness to which we are here quite unaccustomed, but which it would be well to emulate.

So complete was the information as to the state of development of every country, that in one institution visited by the Commissioners, it was obvious that in certain respects, one could *there* readily learn more of the development of our own territory than can be learnt from any one institution in this country itself.

The method and elaboration is often quite ideal; the museums are well arranged; the course is so developed as to give a comprehensive view of commercial life and its possibilities, and at the same time to confer alertness.

Special industries in the neighbourhood often furnish quite unique collections illustrating the commercial side of the industry, and these are of great value. One sees, for example, in a European commercial school, exhibits shewing raw products, with

with maps, diagrams, or illustrations as to the source of supply, the material in various stages of manufacture, and the finished product; and then again, information as the markets for such manufactured material.

Again, every higher commercial school, worthy of the name, has its testing laboratories, illlustrating the chemical, physical, or other tests used in the more ready determinations of quality and purity. And when the testing involves reference to an expert analytical chemist, the student at least knows why such reference is essential, and when it is desirable.

It is easy, in the light of such facts as the above, to recognise in what sense we are devoid of schools for commercial instruction here, and it is equally easy to see how unwise it would be to delude ourselves, by allowing all sorts of primary or secondary schools to *profess* to give commercial education and to affect efficiency by adjusting themselves to meet the examination requirements of some more or less arbitrary standard set by, say, the University, or by some similar body. What is wanted are thoroughly equipped schools, with good teachers: that is important; cramming to pass outside examinations is only intensifying a vicious element already existing in our scheme of public education.

9. *The Teaching Staffs of Commercial Schools.*—A high degree of specialism prevails throughout the teaching-staff of properly equipped commercial schools, especially in those of higher grade, each instructor being an expert in his own subject, and also a *teacher ;* that is to say, he has in most cases studied, and understands something of educational theory. Languages are of course thoroughly taught, and fluent expression in them is regarded as of importance. The instructors are acquainted with the modern methods of teaching languages, a method which confers conversational facility, and the power of acquiring idiomatic expression with great rapidity. The form of correspondence is specially studied, and the students are habituated to the turns of expression, and general phraseology, of courteous business correspondence in each language studied.

The teachers of the important subjects in the higher schools of commerce are thoroughly qualified specialists in their various branches of teaching, and are, as a rule, men of university education and training. To understand the significance of this statement, reference may be made to the Commissioners' Report on Secondary Education. Even in the more elementary business schools, commercial instruction is ordinarily given by *special* teachers. Hence the work is done thoroughly, and the teaching is sound. A teacher who knows nothing of practical business affairs is not the proper man to give some conception of accountancy or book-keeping, and it is well to remember that the mere reading of a book with set-forms is not to be compared for efficiency with instruction given by a teacher with direct knowledge. It is very important that the thoroughness of the European commercial teacher shall be insisted on in any proposed scheme for business education.

Owing to the prevalence in the past of what may be called the purely *literary method* of learning subjects other than literary, it is not so clearly recognised in certain sections of our community, as might be desired, that a person who commits to memory the contents of a work on a professional or scientific subject, is not thereby constituted an expert in that subject.[1] Thus book-keeping and accountancy ought not to be taught by persons who merely purchase a book on the subject, but by persons who have professional knowledge thereof, and similarly in regard to every other subject of a commercial education.

Efficiency of the teaching staff is the secret of the excellence of much of European teaching, and the setting up of a system of test examinations, to be passed by students, is not to be compared for educational thoroughness with the ensuring of good teaching.

10.

[1] Persons have actually passed examinations in chemistry who have never made a chemical experiment, who not only had no manipulative skill, but also could not recognise the substances they could fluently describe. It it no uncommon thing in this State for people to undertake teaching whose only real qualification is that they purchase a book on the subject, and reproduce in a literary way the subject-matter of the book, without having practical experience of any kind. Thus many teachers have expressed themselves as ready to teach any subject under the sun, at any moment. It may seem quite plausible to say that the author of a text-book knows the particular subject, and, therefore, that to reproduce his matter to a pupil is to teach the subject. That, however, is obviously the lowest plane of qualification, and is regarded in Europe as not sufficient.

10. *Growing Recognition of the Importance of Commercial Education.*—Commercial education has been defined as "that form of education which both indirectly and directly prepares the future business man for his calling."[1] This is to be liberally[2] understood, for classical, literary, scientific, industrial, commercial, etc., are terms which, when applied to education, are not essentially exclusive, but rather mark the particular element which is intensified in the various forms of education. Hence, as a school career runs on, it may be increasingly orientated in the direction of commerce, as it may also in the direction of industry.

Each year industry and commerce are becoming more and more highly specialised, and hence a wider range of general knowledge, more definite touch with the conditions prevailing in various parts of the world, and better trained intelligence, are in greater demand for a business career. Faithfulness, industry, regularity, routine knowledge are requisites, but so also is the capacity to form instant and accurate judgments, and these depend upon training and outlook. Routine and rule-of-thumb are less in demand, for modern commercial conditions, at least in the higher grades of effort, require that the business man shall be intellectual rather than mechanical.

The complexity of the relationships of international commerce, and the fact that industrialism and commercialism govern the age, whether we will or no, have necessitated a very different kind of training to that which would have sufficed a few years ago, and the changes of the next two or three decades will doubtless be more rapid than those of the past quarter of a century. The endeavour to establish an opportunity for our young people to get a commercial education should not therefore be restricted to a little instruction in shorthand, in type-writing, book-keeping, accountancy, elementary commercial law, etc., but should be liberally organised, and made of a character more nearly comparable to that to be found in Europe.

The opinion has been expressed by prominent commercial men that the learning of foreign languages is unessential, that the "foreigner" will learn our language, and that is quite sufficient.[3] The penalty paid for this attitude has now been well recognised in America, and it exists no longer. The "foreigner" has been stealing a march in consequence of his better training generally, and his greater assiduity in acquiring the command of other languages, his more thorough acquaintance with business routine. Recently our Commercial Agent in the Far East has pointed out that our ignorance of Oriental languages is a very serious handicap when trading there, and that the advantages fall to the people of another race, because they learn to *speak* these languages. We need to get rid of any insularity which handicaps us in competition, and the best way of getting rid of it is to acquire some knowledge of other languages.

It is now a third of a century since France recognised that her commercial education was lamentably behind-hand, and it is nearly two-thirds of a century ago since Belgium commenced to build up a suitable scheme of commercial education. [Chap. LVI, sec. 1, p. 775.]

France has recognised how largely her defeat was due to defects in her scheme of public education; and openly admits it in connection with the founding of the Higher School of Commerce, Marseilles [Chap. LVI, sec. 1, p. 775, see footnotes also]; and recently America has been aroused to a recognition of the fact that German commercial education has given German traders a considerable advantage in international commerce.

The time is ripe for us to carefully take into account the necessity for founding *good* commercial education, something of a very much more thorough-going character than that which appears to be contemplated by the Chamber of Commerce, and by the University. That a more thorough system is desirable will

---

[1] For example, by Dr. C. A. Herrick in the "Meaning and Practice of Commercial Education." Macmillan, Lond., 1904, p. 6.

[2] Liberal education has to be defined anew, as has been well said by President Eliot, of Harvard. The education designed to enable one to teach classics is as purely technical as any other. Classicists, who are often extremely ignorant in other matters, as, for example, the sciences generally, nevertheless are apt to assume that their education is "general," or "liberal," whereas it may be extremely narrow. Modern educationists recognise the importance of the liberal element in commercial education, in which classics may or may not be present.

[3] Meaning and Practice of Commercial Education, Lond., 1904, pp. 42–3

will be apparent after a perusal of the chapters of the present Report, dealing with the subject. That we have no commercial education at present worthy to be compared with that of Europe and America will be manifest on reading the detailed chapters.

That New South Wales commerce is of sufficient magnitude to unequivocally indicate the necessity for commercial education is apparent when it is borne in mind that the total trade with British countries was over 40 millions sterling and with foreign countries about 13½ millions sterling in 1903; 53½ millions in all.

It is when a fact like this is taken into consideration that the growing significance of such words as those of Dr. Herrick's are perceived, where he says:—"Commercial instruction can contribute to a better regard for society's intricate industrial organisation; in addition, such instruction will at once equip for economic leadership, and for efficient service in subordinate positions. This is more than the training of heads of departments, general superintendents, and the like. The success of the commanders will depend largely on the quality of the men who serve under them."

Dr. Herrick quotes with approbation Herbert Spencer's remark shewing the importance of proper education even for the subordinate, viz., "*How vastly would the work of production and trade enlarge were the rank and file all so efficiently trained as to be faultless in the discharge of duty* though not competent for the rank of commanders?"[1] And then he—Herrick—goes on to say: "The men engaged in commerce, and society at large, need a new estimate of the importance of commerce. Business men have opportunities to perform in business splendid social service—to be real benefactors. Men of affairs should be led to look to affairs directly as means of progress, instead of relying entirely on indirect agencies that are offsprings of business success;—thousands of operatives more intelligently trained for their special callings, with higher standards of living, with a new intellectual and economic outlook,—surely this is a substantial gain, not to be surpassed by founding schools to educate men out of their economic station, or endowing institutions to care for the economically unfit."

If such views do not convince, then at least the extent and perfection of commercial education in other countries will warn us that this branch of education has been neglected no less than others. At least let us not hide from ourselves the fact that we have as yet practically no such thing as commercial education.

---

[1] Education.

XV.

HIGHER COMMERCIAL EDUCATION.

[G. H. KNIBBS.]

1. *Object of Higher Commercial Education.*—Through the intricacy of modern civilisation, commerce and commercial pursuits have come to assume a more dignified place than formerly, and, as a result, higher educational institutions endeavour to find a place for such forms of instruction as will be of direct service to those who intend to embrace a commercial career. The view that only certain professions are *liberal* is largely responsible for the hostile attitude of Universities in England towards the inclusion of instruction for those who desired to enter the career of a civil engineer, of a chemical technologist, the commercial career, and others of like nature. Touching this assumption of liberality, however, it has been said: " Why is not agriculture as liberal a profession as that of an attorney? A liberal profession is just worth what its actual votary is worth. An indifferent physician, an average barrister, a third-rate *littérateur*, are singularly less interesting beings, and of much less social value, than not only an intelligent manufacturer, but even a good farmer, a clever and honorable tradesman, or a skilful workman, whether mechanic, carpenter, or mason."[1] The same query may, of course, be raised as regards careers in various branches of commerce. It is to the attainment of this clearer perception of the natural dignity and the social and economic value of a commercial education and career, that the world owes the constitution of Higher Schools of Commerce, schools in which a commercial *corps d'élite* may be educated and trained, and where the higher grade of instructors in commercial education can be prepared for their office.

2. *Higher Commercial Education in the United Kingdom.*—The Faculty of Commerce in the University of Birmingham must be taken as expressing a deliberate opinion as to what constitutes a commercial education from the English point of view, for this University was organised after a deliberate study of the question of adapting University education to the modern needs of mankind. It is hardly necessary to say that the necessity for better commercial education in the United Kingdom is admitted by practically everyone competent to judge.

An account is given in the report hereinafter of the course leading to the *Bachelor of Commerce* degree in the University mentioned. [Chap. LI, secs. 3, 4, pp. 723–5.] The matriculation conditions are slightly different from the conditions in other faculties. The calendar has advisory clauses, recommending, for example, freehand drawing, geometrical drawing, and shorthand, besides matriculation subjects [p. 724 herein]. The Faculty reserves the right of postponing a student's admission, notwithstanding matriculation, on the ground of immaturity, and may advise the spending of a year in the workshop or the counting-house. The English custom of *passing an examination* at the end of *each* of the three years is maintained; this includes *vivâ voce* examination in the foreign languages taken. The other parts of the examinations are as follow:—

1*st Year*.—Commerce; any two of the following languages, viz., French, German, Spanish, Italian; accounting; European history since the French Revolution; one of the following, viz., pure or applied mathematics, physics, chemistry, logic; and two of the following, viz., geography, elementary psychology and logic, British institutions.

2*nd*

[1] See Edmond Demolins: " Anglo-Saxon Superiority; to what it is due." New York, 1898. Page 322.

2nd Year.—Commerce, languages, and accounting as before; public finance; economic analysis; one of the following, viz., pure or applied mathematics, physics, engineering, metallurgy; *or* two of the following, viz., geography or geology, ethics, history and institutions of France, history and institutions of Germany, history and institutions of Spain and Spanish America.

3rd Year.—Commerce, languages, and accounting; commercial laws; transport; then subjects (at least three) from among the following, viz., (i) technique of trade; (ii) money, credit, banking, international exchange; (iii) methods of statistics; (iv) factory hygiene and legislation; (v) physics, chemistry, engineering, metallurgy, economic geology, electrotechnics, brewing, mining. Not more than two subjects, however, may be taken from group (v).

The fees are £21 for all subjects, and £11 for examinations, £32 in all. Fees for individual courses range from 1½ to 4 guineas.

Other courses are by no means identical with the above—see for example the account of the Faculty of Commerce of the University of Manchester in the Report. [Chap. LI, sec. 8, pp. 728–731.]

Since the Commissioners visit, the old *Victoria University*, including the colleges of Liverpool, Manchester, and Yorkshire (Leeds), has been dissolved, and in its place three independent Universities are being established. These will all possess faculties of commerce.

The higher schools of commerce in England have experienced some difficulty in getting students for day courses, and the Yorkshire College recognised the value of students spending a part of the day in "the office, the mill, or the works." This is, of course, a concession.

3. *The departure from the standards and traditions of the older English Universities.*—The opinion that commercial education may properly become an integral part of the whole system of public instruction of England is very wide-spread and has been influentially voiced[1]. The constitution of the Birmingham University was the outcome of the recognition that the attitude of Universities of the type of Oxford and Cambridge was not helpful in many things of great national moment, and the organisation of that University was deliberately planned so as to meet the conditions now existing in the world of industry, commerce, and trade.

Professor Ashley, who is mainly responsible for the scheme of the commercial school or faculty at Birmingham, was formerly a fellow of Oxford, and later a professor at Harvard. He called attention to the desirableness of changing the fixed ideal, not only of the English but also of the American Universities[2], contrasting them with German institutions of similar grade. It is alleged that the Birmingham development is to *supplement* rather than to *oppose* the work of the older universities; but in announcing that the studies would be grouped under the headings (1) languages and history, (2) accounting, (3) applied science and business technique, and (4) commerce, it was openly affirmed that the last would be the distinctive feature[3]. The situation may demand that the policy of the tactician be paramount, and that the real situation be disguised, but the facts shew clearly enough that the university which meets the needs of the highest forms of education for civilised life as it is found to-day, is not that which neglects modern languages, science and its applications, technology and commerce, but that which takes these very thoroughly under its care in such a way as to make the necessary education cultural and consequently liberal.[4] And it is now widely recognised that the attitude which metaphorically closed the doors of the university against those who preferred to read modern rather than dead languages, is not liberal, and that Latin has no special claim

[1] For example, by Sir Michael Hicks-Beach.

[2] "The Universities and Commercial Education." North American Review, January, 1903.

[3] Purpose and programme of the Faculty of Commerce in the University of Birmingham, etc. W. J. Ashley, p. 7, 1902.

[4] The learning of the dead languages can be better promoted by more efficient methods of teaching, as has been shewn in the two earlier Reports. To attempt to maintain the study of them by merely refusing to admit as regular students those who will not or cannot learn them, would be unwise, and may recoil on the head of whoever makes the attempt.

claim entitling it to be singled out as a subject which must be studied by all. The modern movement in England educates for a broader and more practical life, for the humanities as they exist under modern conditions.

If the Sydney University intends to promote commercial education, it will be necessary for the matriculation for commerce to abandon the insistence on Latin as a matriculation subject.

It has been suggested that the real remedy in England is to modify existing universities and schools, rather than to pile up the number of specialised forms of each.[1] Cambridge now allows the taking of a B.A. in economics. On the other hand it may be said that the special schools of Europe, following on a good secondary education, lead to a degree of thoroughness of training to which English educational organisation cannot at present attain.

4. *Higher Commercial Education in America.*—Commercial education in America was privately organised about 1824 in New York[2], and about 1834 in Philadelphia[3]. A little later, viz., in 1853, the celebrated Bryant and Stratton business colleges started, and were organised in what was called a "chain" with uniform text-books and interchangeable scholarships. Bryant and Stratton attempted to monopolise commercial education, and to crush all competitors, but were defeated. They, however, appear to have laid the foundation of liberal ideas of a commercial training, and this, no doubt, is the sufficient reason for American appreciation of the necessity for higher commercial education, as well as for secondary and lower forms.

The following institutions in the United States may be mentioned as providing instruction of the highest grade:—

HIGHER SCHOOLS OF COMMERCE IN THE UNITED STATES.

(1) *Wharton School of Finance and Economy,*[4] University of Pennsylvania, Philadelphia. Opened in 1881, with a two-years course, becoming a four-years course in 1895.

(2) *School of Commerce,* University of Wisconsin, Madison. Suggested in 1866, inaugurated in 1900, varied in 1904.

(3) *College of Commerce,* University of California, Berkeley, San Francisco. Opened in 1898.

(4) *College of Commerce,* University of Chicago, Chicago.

(5) *Commercial Division* in the University of Michigan, Ann Arbor.

(6) *Commercial Division* in the University of Illinois.

(7) *Department of Commerce and Economics,* University of Vermont. Endowed, 1900.[5]

(8) *Amos Tuck School of Administration and Finance*[6], Dartmouth College. Founded in 1900.

(9) *School of Commerce, Accounts, and Finance,* New York University. Founded in 1900.

Besides specially organised higher schools of commerce, of which the above is by no means a complete list, there are numerous courses in history, economics, modern languages, geography, etc., not very dissimilar to those in the specially organised schools, and more or less commercially correlated. These exist, for example, in such Universities as Columbia, Cornell, Johns Hopkins, Harvard, Yale, etc. With the liberal options of the American system of elective courses, the scheme of some of these institutions may differ but little from the specially organised ones.

5.

[1] In the Magazine of Commerce.

[2] By F. G. Bennett.

[3] By R. M. Bartlett.

[4] Founded through Mr. Joseph Wharton's gift of $100,000, increased later to $250,000, to which $250,000 has since been added. Mr. Wharton gave also a site and building worth $240,000, making his total donation $740,000—roughly £154,000.

[5] By Mr. John H. Converse.

[6] Founded through a gift by Mr. E. Tuck of $400,000—roughly £83,000.

5. *Curricula of American Higher Schools of Commerce.*—The curricula in the different schools are by no means alike. For example, in the University of Wisconsin, the subjects are the following, viz:—

1*st Year.*—Physical geography and physiography of the United States; German, French or Spanish, and English; mathematics; English or modern European; political and economic history; drill and gymnastics.

2*nd Year.*—Commercial geography; foreign languages and English; mathematics, chemistry or physics, elementary economics; accounting and auditing; drill and gymnastics.

3*rd Year.*—Money, banking, transportation; foreign languages; American history; business practice; and elective studies.

4*th Year.*—Commercial law; foreign languages, business practice, and elective studies.

The curriculum of the Amos Tuck school is quite differently arranged to the above. It runs as follows, viz.:—

1*st Year.*—Survey of history of economic theory; status of labour in chief industrial nations; natural history of money, credit, history of monetary legislation, of banking, detailed discussion of banking operations; rail and water transportation, theories of rates, consideration, legislation and control; governmental expenditures and revenues, taxation, debt, financial administration; commercial geography, treating of the extractive and manufacturing industries, viewed from a technical standpoint; comparisons between the development of all important countries; statistical investigation of various phases of economic development.

European political history from the French revolution to the treaty of Berlin (1789–1878), and the history of the United States between 1783–1877.

History and explanation of existing international relations, critical comparison and study of the constitutions, and working of the governments of England, France, Germany, and the United States.

The classification of population as affected by physical and social causes, vital statistics, investigation of crime, pauperism, and social reform.

The relation of man to his physical environment and the forms of economic life.

Languages, French and German, advanced composition and conversation; Spanish, composition and conversation; English, commercial corespondence.

2*nd Year,* which is considered a post-graduate year.—Opening, conducting, and closing accounts of manufacturers, dealers, etc., in investment securities, balance-sheet, cost, depreciation, goodwill, profit and loss, examination of accounts with reference to credit, insolvency, capitalization, conversion of partnership to corporation, accounting, auditing; cost determinations; forms of investment securities, corporation "financiering"; analysis of reports, study of money markets, stock and produce exchanges in United States and foreign countries.

Principles, forms, and legal phases of investments; analysis of typical institutions; stock exchange methods

Powers and duties of corporations and their officials, organisation and control.

Real and personal property, contracts, negotiable instruments, agency, carriers, insurance, trustees.

Status of persons engaged in business under foreign jurisdictions, foreign commercial codes, international commercial law.

Bankruptcy and law relating thereto.

Statistical studies of business methods and experience, mathematical principles and details read by administrators, financiers, brokers, etc., including brokerage, interest, insurance and bond tables, etc.

American political parties since 1873.

International negotiation, typical cases, organization of foreign diplomatic and consular services.

History, character, and existing circumstances of Canada, Mexico, Australia, and principal countries of South America, Asia, and Africa.

Advanced

Advanced composition in French, German, and Spanish, with special reference to commercial needs.

The extractive industries of the United States, their history, resources, technique, and markets. Manufacturing industries, with technical study of typical industries. Organization and management of large industrial plants, including questions of labour, cost, markets, competitions.

Organization and methods of trades' unions, study of fundamental economic relations between employers and wage earners.

Analysis of existing commerce of United States, international routes, tariff-laws, commercial treaties.

Actual methods of trade with foreign countries, viz., South America, Africa, Australasia, China, and Japan, England, Continental Europe, following products from sources to consumers; the more important aspects of scientific problems which play a part in industrial affairs. Economic chemistry, economic botany, economic mineralogy, materials of construction, motors, etc.

The organisation, operation, and law of national, state, private, and savings banks.

The organisation, operation, and practical problems of railroad business; railroad accountancy, maintenance, revenue, disbursements; practical aspects of lake, river, and canal traffic.

Study of life insurance in all important forms.

The practical value of such a curriculum is beyond question: it is essentially a technical course of great comprehensiveness, and is worthy of the title, "Higher Commercial Education."

6. *Higher Commercial Education in France.*—According to the Inspector General of Technical Education in 1889,[1] only about 2,000 out of 400,000 French youths entering on a commercial career received a commercial education, but since then matters have altered.[2]

Higher commercial education in Paris is represented in such a school as the "*Ecole Supérieure de Commerce,*"[3] and in the "*Ecole des Hautes Etudes Commerciales.*" Both these schools have day and resident students.

The finely organised curricula of the French Higher Commercial Schools[4] may be grasped by a reference to Chapter LV, secs. 1–37, pp. 758–774, giving an account of the "*Ecole supérieure de Commerce de Lille,*" and to Chapter LVI, secs. 1–34, pp. 775–785, giving an account of "*Ecole supérieure de Commerce de Marseille.*"[5]

The entrance conditions are severe. The fees are rather high, but there are bursaries to enable poor students to attend.

The entrance examination requires certain definitely specified knowledge [see Chapter LV, sec. 10–16, pp. 760–763], in arithmetic, algebra, geometry, chemistry, physics, geography, and history.

The programme is as follows:—

Subjects.	Years—Hours per week. I.	II.	Subjects.	Years—Hours. per week. I.	II.
Commerce, Accountancy	7	6	Fiscal and Customs Legislation and Political Economy	...	2
English (Obligatory)	4	4	Transport and Plant	1	...
German or Spanish	4	3	Organic Chemistry	1	...
Mathematics	1	2	Trade in Textiles, Thread, and Fabrics	...	2
Technology of Merchandise, Tests ...	2	1	Caligraphy	1	...
Economic Geography	2	2	French, Commercial Correspondence	2	1
History of Commerce	...	1			
Elements of Public and Civil Law ...	2	...	Totals	27	27
Commercial and Marine Law	...	2			
Industrial and Workman's Legislation	...	1			

[1] M. Jacquemart.
[2] French contempt for "*la carrière mercantile*" is disappearing.
[3] It was founded in 1820, and was installed in its new quarters in the *Avenue de la Republique*, in November, 1903.
[4] Strange to say, a British Consular "Report on Commercial Education in France," affirms that higher commercial training is very defective.
[5] See also Chapter LIV, secs. 10, 16, 17, pp. 755, 757.

The

The Marseilles school has a preparatory year, the programme of which is as follows:—

Subject.	Hours per week.	Subject.	Hours per week.
French	5	Chemistry	2
Foreign Language (English)	5	Physics...	2
2nd „ (modern)	1	Geometry	2
Accountancy	2	Caligraphy	2
General Geography	3	Physics and Mechanics	...
History	1	Plane Trigonometry	...
Arithmetic and Algebra...	7		
		Totals...	32

The programme of the course itself is somewhat different to that of the Lille School, as will be seen from the details hereunder:—

Subjects.	Years—Hours per week. I.	II.	Subjects.	Years—Hours per week. I.	II.
Commerce and Accountancy ... / Mathematics as applied to commerce	11	10	Political Economy, History of Commerce	...	1
			Marine "*Armements*"[1]	...	2
English	5	4	French and Commercial Correspondence	2	2
A second Language	3	3	Caligraphy	2	2
Technology of Merchandise[2]	3	3	"*Conferences*"	...	3
Economic Geography	3	3			
Commercial, Maritime, and Industrial Legislation	2	2	Totals	32	36
Labour, Fiscal and Customs Legislation	1	1			

The above programmes give, of course, very little idea of the thoroughness of the instruction, and a reference to the body of the report is necessary to appreciate the elaboration with which the whole is worked out. For example, at Lille, under the heading of commerce and accountancy, the treatment covers the following, viz.:—

Commerce; wholesale, retail, internal, and foreign trading; the functions of merchants, manufacturers, bankers, exchange-brokers, stock-jobbers, merchandise and maritime brokers, commissioners, representatives, clerks, commercial travellers, etc.

Exchange in kind, etc., commercial exchange, buying and selling in all forms, markets and sources of supply, computations of profits.

Documents, such as buying and selling orders, invoices, notes, receipts, memoranda, commission, delivery, receipt, samples. Exchange regulations, concerning money, bank-notes, paper money, cheques ordinary or crossed, money orders, bills of exchange, *mandats,* delegation, letters of credit, bills, etc.

Transport by rail, canals, rivers, or sea; insurance, invoices, bills of lading, bonded warehouses, bankers and banking business, the London clearing house, the function of the Bourses, merchandise exchanges, and brokers; investments, annuities, societies for credit or industrial enterprises, the Credit Foncier, treasury-bills, savings banks, current accounts, cash operations, states of markets; life, fire, and accident insurance; business syndicates, and the management and accountancy of business concerns of various kinds [p. 764].

The elaboration of other courses is similar. *The Ecole des Hautes Etudes Commerciales* in Paris declares that its object is to prepare for careers in commerce, industry, banking, the railway service, consular, ministerial, and administrative positions, and also to prepare for *commercial teaching*; and in a section of the school the *diploma* of a commercial teacher is conferred. The

[1] Material and equipment of a vessel.
[2] The *Etudes des marchandises* (*Waarenkunde* in German) are a feature, and are very thorough in their way.

The various schools of France reflect, to some extent, the local forms of commercial and industrial activity. For example, that at Lyons has a series of studies common to all sections, and the remainder differ. The sections are:—

(i) General commercial and banking studies; (ii) studies preparatory to the silk trade and industry; (iii) studies preparatory to trade in dyeing and chemical products.

The courses, it will be seen, though essentially vocational, are undoubtedly liberal and comprehensive; and, coming as they do after a broad educational preparation, they are certainly very valuable from every point of view, cultural or professional.

7. *The Higher Institute of Commerce, Antwerp.*—The idea of a higher institution for commercial education in Belgium was mooted as early as 1847,[1] and as a result the Higher Institute of Commerce was opened in Antwerp in 1852. Its course was extended in 1897 to three years. About one-third of the students are foreigners.

It may be mentioned that in 1893 the Belgian government and the Supreme Council of Industry and Commerce considered the question of proper preparation of candidates for the consular service, with the result that the universities of Gand (Ghent) and Liège, and the Higher Institute of Antwerp, were empowered to confer the "*licencié du degré supérieur en sciences commerciales et consulaires,*" *etc.* The lower degree, for a two-year course, is the "*licencié en sciences commerciales*" simply.

The whole organisation and the curriculum is outlined in the Report [Chap. LIII, secs. 1–37, pp. 741–750] to which reference may be made. The institute possesses a very fine commercial museum.

8. *Higher Commercial Education in Germany.*—As far back as 1866 Matthew Arnold referred to the German school system as something to "excite the foreigner's admiration," and the German commercial schools form no exception to the general excellence. Among the fine schools for higher commercial education may be mentioned the *Handelshochschule* of Leipzig, which occupied a new building in October, 1902, in the Schulstrasse. It had over 400 students in 1903. It is closely associated with the Leipzig University, its students being admitted to the University courses, and matriculates of the University are admitted to the *Handelshochschule.* Although a special school, it has not departed from the fine *akademische Freiheit* of German higher educational institutions. All attendance is voluntary[2] and the fears which were entertained at one time, viz., that the students might be lacking in industry, have proved foundationless. Excursions are arranged to industrial and commercial enterprises in Saxony as a regular part of the course, and it may be mentioned that both merchants and manufacturers give every aid, sometimes even entertaining the students.

The course is two years for the commercial diploma. Besides this, a teacher's diploma is issued—the candidate is required to give a practical demonstration of his ability to teach and to produce a thesis on some subject connected with commercial education.

The Leipzig school is in touch with the *Handelshochschule* of Köln (Cologne) at which the entrance conditions are much the same as at Leipzig. The course is also two years, of which one year may be spent at Leipzig. There is also a teacher's "Seminarium" for those who desire to be teachers of the lower commercial schools.

The Berlin *Handelshochschule,* recently constituted, is very similar to the Cologne and Leipzig institutions. The principal divisions of the subjects studied are as follows, viz.:—

(a) *Political Economy.*—Banks, exchange, money, credit, partnership, trade, commercial industries, colonial and social economy, statistics, finance, insurance, economic geography, history of commerce.

(b)

[1] By the Belgian Minister for Foreign Affairs. Immediately afterwards a Belgian merchant produced a monograph entitled "A Proposition for the Organisation of a Belgian University of Commerce and Industry."

[2] In the English University system, attendance is compulsory. The professor may be well worth hearing, or *vice-versa,* the student must attend lectures or he will not be admitted to examination. The English system treats the student rather as a schoolboy to be coerced than as a man to be entrusted with serious attention to his own interests.

(b) *Law.*—The bases of civil and commercial law, laws of exchange, maritime law, insurance law, social legislation, protection of industries, laws of patents, copyrights, trade-marks, etc., international trade; state, administrative, civil, and criminal law.

(c) *Materials of Commerce.*—Physics, chemistry, mechanical and chemical technology, industrial hygiene.

(d) *Commercial Technique.* — Bookkeeping and accountancy, commercial arithmetic, correspondence.

(e) *Languages.*—English, French, German, Italian, Russian, Spanish.

(f) *Commercial Teaching.*—Students taking up commercial teaching are afforded opportunities for practical experience in commercial schools.

Frankfurt[1] has an academy for social and commercial science, organised very similarly to the Leipzig Higher Commercial School. It confers upon those of its matriculates who pass the final examinations a commercial diploma. This academy was opened in 1901, and had an attendance of over 500 not very long after its opening.

The *Technische Hochschule* of Aachen has a commercial section, the work in which is very similar to that of the other higher schools. This section was opened in 1898.

It may be mentioned that Dr. Rein of Jena, points out in an article in the *Nineteenth Century*, that these schools of industry and commerce have already become an organic part of the German educational system. While the schools are certainly vocational, and thus in the highest degree practical, they are undoubtedly also educational in the highest sense of the term.[2]

9. *The Higher Commercial Schools of other Countries.*—The *Handelsakademie* of Vienna is not only the most famous in *Austria*, but one of the best in the world. It has sometimes 1,000 students in attendance. The course is four years and an optional fifth year has quite lately been added. Some idea of the type of programme in the Austrian and Czech Higher Commercial schools may be had by referring to the programmes in the Report [Chap. LIV, sec. 5, p. 752; sec. 8, p.754.]. The following is the programme of the *Handelsakademie* of Olmütz, the hours for obligatory subjects being 33 to 34 per week.

Subjects.	Years—Hours per week.				Subjects.	Years—Hours per week.			
	I.	II.	III.	IV.		I.	II.	III.	IV.
I. *Obligatory*—					Commercial Geography...	2	2	2	2
German Language (as language of instruction)	4	3	3	3	General and Commercial History ...	2	2	2	2
French Language and Correspondence...	6	4	4	4	Natural History	...	...	2	...
English or Czech Language and Correspondence	...	6	5	4	Physics	3	...	...	...
Commercial Arithmetic	4	4	3	4	Chemistry and Chemical Technology ...	...	2	2	2
General Arithmetic, Algebra, and Geometry	4	2	2	...	Technology of Merchandise and Mechanical Technology	...	...	...	3
Correspondence and Counting-house Practice	2	2	3	3[3]	Caligraphy and Typewriting	2	2	...	...
Book-keeping and Accountancy... ..	...	2	3	3[3]	Stenography	2	2	...	...
Model Counting-house Exercises ...	...	..	...	6[4]	II. *Optional*—				
Theory of Commerce	2	...	...	..	Practical Exercises, Chemical Laboratory	...	3	3	3
Exchange Law	...	...	2	...	Practical Exercises, Laboratory for Testing Merchandise...	...	...	...	3
Commercial and Industrial Law ...	...	...	...	2	Gymnastics	2	2	2	2
Domestic Economy	...	...	...	2					

[1] On the Main.

[2] The testimony of Dr. C. A. Herrick is that "Commercial education in Germany has been *education*": the italics are his. "Meaning and practice of Commercial Education" p 100. Macmillan, New York 1904.

[3] 1st Semester only.

[4] 2nd Semester only.

Commercial

Commercial education was splendidly developed in *Hungary* as far back as 1857, as the programme in the Report will shew [Chap. LVIII, sec. 2, p. 793]. The highest form of commercial education is given in what may be called *Superior Commercial Institutes*, which provide :—

(*a*) A special course of commerce for the licentiates of the secondary schools.
(*b*) An academy for Oriental commerce.
(*c*) A normal school for instruction in commercial teaching.

For a fuller account of these, reference may be made to the Report [Chap. LVIII, secs. 17–21, pp. 800–803].

The programme of the section for commercial teachers is as follows :—

Subjects.	Hours per week. I.	Hours per week. II.	Subjects.	Hours per week. I.	Hours per week. II.
Political Arithmetic	2	2	Commercial Geography	2	...
Calculation of Probabilities	1	...	Mechanics, Technology, etc.	...	2
Commercial Arithmetic	2	2	Political Economy	2	...
Book-keeping and Accountancy ...	2	2	Hungarian Commercial Style	1	...
Hungarian and German Commercial Correspondence and Ideas Concerning Commerce	2	2	Methodology of Commercial Teaching.	1	...
			Total... ...	15	10

The candidates for commercial teaching not only go through the courses indicated in the preceding programme, however; they also attend such courses of the University or Polytechnical High School as the Director of the Normal School advises; they attend the exercises of the Commercial Teachers' Seminary; they assist in the courses of the Commercial Academy; they hold conferences for the discussion of professional subjects; and they visit banks, counting-houses, factories, dockyards, etc.

Among other Higher Schools of Commerce worthy of special study, may be mentioned the Royal Higher School of Commerce in Venice, *Italy*, which has the first year of its programme common to all sections, and then divides under several sections, viz. :—

(*a*) A commercial section, in which the diploma may be obtained in two years or more;
(*b*) Teaching classes for merceology (technology of merchandise); and also for—
(*c*) Accountancy, with courses of four years in all;
(*d*) A Consular section; and—
(*e*) Teaching classes in law, economy, and statistics; and also—
(*f*) In foreign languages; each with five years' courses.

Pupils are received at 16, hence their diplomas are obtainable at 19, 20, or 21 years of age, as the case may be. This school was founded in 1868, and is now housed in the Palazzo Foscari, on the Grand Canal. It is well equipped. For fuller particulars, see the Report. [Chap. LIX, sec. 11, pp. 812–4.]

The two special sections of the Peter the Great Commercial School of *Russia* are also worthy of study. [Chap. LIX, sec. 18, pp. 816–7]; in fact, the whole programme is illustrative of Russian ideas of good commercial education.

Kristiania, the capital of *Norway*, has a Commercial Gymnasium (*Handelsgymnasium*), the programme of which is given in the Report. [Chap. LIX, sec. 12, p. 814.] It is housed in a building of three storeys, well laid out and equipped.[1]

The professional sections of the *Handelsinstitut* in Gothenburg, *Sweden*, and of the Stockholm Institute are also Higher Commercial Schools. [Chap. LIX, secs. 13–16, pp. 814–5.]

The scheme of the *Ecole de Commerce* of Neuchatel, in *Switzerland*, is one of the finest examples of commercial education in the world, and is very well organised. A lengthy account[2] is given in the Report. [See Chap. LXI, pp. 834–845, Mr. J. W. Turner.]

It may be mentioned that there is a Bachelor degree in commercial science (*baccalauréat ès-sciences commerciales*) at Fribourg, in Switzerland. 10.

[1] An excellent account of this is published by Prof. Polaczek: *Historiske Oplysninger om Kristiania Handelsgymnasiums Oprettelse og Udvikling i de Forlöbne* 25 *Aar ved Direktör Professor C. Polaczek.* This is a "*Festskrift.*"

[2] By Mr. J. W. Turner.

10. *The Equipments of Higher Schools of Commerce.*—Something has already been said of the equipments of Commercial Schools. [Div. XIV, sec. 8.]

One of the features in many of the higher vocational schools of commerce is the *commercial bureau.* A description of one, by no means absolutely the best seen, may be taken at random, viz., that of the Geneva Commercial School. In this the bureau is constituted as a Mercantile establishment, performing each type of operation, with the bank, merchandise, etc., on its own account, on commission, on joint account, etc. The instruction covers such matters as buying orders, net cost, business arrangements or agreements, despatch of goods, etc.; bills of exchange, bills for settlement, for endorsement, bills of lading, warrants, insurances, outstanding debts, general and particular averages, loss by storm, fire, shipwreck, capture, etc.; balance-sheets, liquidation. Correspondence is in French and other languages. All transactions are regularly registered, and the books are kept in double-entry system.

Each pupil, in turn, occupies the various positions in the fictitious establishment, as principal or director, cashier, accountant, correspondent, warehouseman, etc., etc.

This represents the first year's work of six hours per week. In the second year the complication of the operations is increased, and include transactions in public funds, in liquidations, accounts with foreign houses, arbitrations, and American accountancy.

A study is made of various special matters—brokerage, commission, speculations, banking, and insurance. The class is divided into various mercantile establishments, some having their fictitious headquarters in Switzerland and some in foreign lands, business correspondence and transactions proceeding between them.[1]

This arrangement gives definiteness to the operations and demands good organisation.

A second feature is the often excellently-equipped *chemical, physical, and microscopical laboratories;* with *testing apparatus,* etc. For example, in the Geneva Commercial School two hours a week are devoted to work with the microscope and in the chemical and physical laboratory. The Commissioners had the advantage of seeing the students at work, and the excellence of the tuition was evident.

The demonstrations illustrate the utility of the microscope for the examination of merchandise in respect of quality and purity. Descriptions of the simple and compound microscope and general rules for microscopical observations, for the preparation of slides, for making sections, in the technique of preserving and staining liquids, etc., are given and made by the professor, and the mode of determining various kinds of adulteration.

Examinations of alimentary substances, from a chemical and microscopic point of view, are made. These include such substances as farinas, spices, spirituous liquors, wines, beers, spirits, vinegars, oils, milk, etc. Meats and the products offered by the pork-butcher, are examined with regard to leprosy, trichinosis, etc. Verifications of ivory and of the various animal and vegetable products substituted for it are made. The fibres of cotton, wool, silk, flax, hemp, jute, ramie, are recognised, and their proportion in the textile fabrics determined. Analyses are made of papers, of tapestries, and to determine forged handwriting. Culinary material, varnishes, oil-cloths, etc., are examined, and animal and vegetable colouring-matters tested. Colorimetry, the analysis of tobaccos, the origin and quality of the hair employed in hat-making and the fur trade, and similar matters, occupy the pupils.

To undertake these several things, the laboratory is fitted with the most recent apparatus used for the examination of raw and manufactured materials.

The *commercial museums,* which are essential to the proper functioning of the commercial school, are usually quite elaborate. They illustrate in a very complete way the technology of merchandise. Raw and manufactured products, illustrations of their vegetable or animal origin, articles in each stage of manufacture, various qualities of particular commodities, pure substances and their common adulterated forms and the adulterants, the stages of testing, natural and synthetic products, diagrams or views of processes of manufacture, of machinery, and similar material are what are to be found in the commercial museums of Europe.

The

[1] Jahrbuch des Unterrichtswesen in der Schweiz, 1900. Zurich, 1902 (sec. 2), pp. 252–254.

The *projection-lantern* is largely used for familiarising the student in a realistic way with commercial geography, and with processes of manufacture, the development of industries, and so on. In Neuchâtel, Switzerland, for example, the series of slides gave an amount of information about Australia, that, so far as the Commissioner knows, is not even yet to be had in the Commonwealth itself, in the same convenient form.

11. *General Remarks.*—The development of commercial courses within Universities, while undoubtedly valuable, is not to be compared in thoroughness with the method of establishing well-organised higher schools of commerce. In the latter, each subject is specially orientated with regard to commerce. Chemistry, as taught in most universities, for example, is not of the type required for students in commerce, and it would be quite a mistake to suppose that a student taking a course of chemistry in the Sydney University, for example, was doing something which could be compared in efficiency, from the standpoint of commercial education, with the courses in chemistry in the higher commercial educational institutions of Europe.

Probably the best type of organisation is that of Leipzig, where the University and Higher Commercial School are in close association, though distinct from each other.

The university equipments are not of the special type required in the commercial schools, and the necessary practical work would run the risk of being somewhat neglected or imperfectly organised.

The Continental and the better American Commercial Schools are, undoubtedly, very fine institutions, and to see them is to feel that there is some force in Professor Pearson's view that we are being beaten in the race by neglect of an important element of education, namely, that which fits for the commercial career.

We need to free ourselves from the domination of those *insular folk* who fail to see that the truth is not compassed by such a mere truism as "each nation must build up the educational system best suited to its own requirements and best adapted to the national genius of its people"[1]; rather should we place ourselves under the guidance of those who feel that "of all species of extravagant waste, there is none more unpardonable than that which permits one nation to remain in ignorance of the clever and successful methods devised in another for gaining important ends."[2]

"Ten years" residence and study in Germany, said Mr. Harris, in a consular report, "has led me to the belief that this great Empire's greatest capital is its intelligence. A process of rigid training has not only enabled Germany to overcome the disadvantages of her geographical position, but the merchants and manufacturers of England find themselves face to face with the fact that German commerce has much more rapidly increased than their own, and that many markets in different parts of the world are being lost (by passing) to German competitors."[3]

Higher commercial education surely is a factor of some importance in enabling British subjects to hold their own in the great industrial and commercial struggle, which everyone not blinded with insular pride, or betrayed by insular arrogance, can see developing with amazing rapidity.

---

[1] Fabian Ware. Educational Foundations of Trade and Industry, 1901, p. 56.
[2] New York *Nation*, 31st Aug., 1899, p. 174.
[3] United States Consular Report, January, 1904.

XVI.

SECONDARY COMMERCIAL EDUCATION.

[G. H. KNIBBS.]

1. *Types of Secondary Commercial Education.*—In the preceding division, commercial schools of the types (1) and (2), referred to in this summary [XIV, §7], have been discussed. Types (3), (4), and (5) will now be reviewed, viz., secondary commercial schools, commercial sections or departments of secondary schools, and evening commercial schools of secondary grade.

It is important to distinguish between these and what are known in this State as the modern and commercial sides of grammar schools or other forms of secondary schools. Secondary commercial schools are *not* merely schools of *general* preparation for a commercial career; they are essentially special, although they may also contain the elements of general education; in other words, they may advance general education, while at the same time they definitely prepare for the commercial career in contradistinction to other careers.

The organisation of such schools, as one might expect, is very varied. But in one regard they are alike, viz., they are schools which are developed under definite curricula. In this respect they are quite different to that type of institution which, though styled commercial or business college or school, really teaches independent subjects useful to those who enter the commercial career.

It may further be stated that the secondary commercial education of some countries, or in some instances, is quite equal to higher commercial education in others.

The forms of secondary commercial education in various countries will now be referred to in alphabetical order.

2. *Secondary Commercial Education in America.*—In the United States it is now educationally recognised that neither the University commercial course nor the Commercial High School is the necessary apex of the Secondary Commercial School, so that the latter must be regarded as in itself a terminating point of one form of education. A "*committee of nine*" experts in commercial education, appointed by the Detroit Meeting of the National Educational Association,[1] in dealing with the question of an ideal form for the Secondary Commercial School, recognised that but "an insignificant percentage" of students go on to the courses in Colleges or Universities. In an educational system, the University is the highest of a number of terminal branches rather than the summit of an educational pyramid. Hence the classical domination,[2] which has so seriously fettered and hindered English educational development, and which has practically come to an end even in England, is a thing of the past in America, as it is, indeed, almost throughout the world, though *not in this State.* President Eliot, of Harvard, has warned educationists against any attempt at uniformity of school products, and it is becoming more clearly perceived that the so-called "dull" or "stupid" student, according to the classical school administrator, is often merely one who recoils from dull, mechanical, and unscientific method

[1] Of which association the Commissioner here writing has the honour to be a member.
[2] "Education in the United States," says Dr. Herrick, "following the English ideal, has been too severely and too narrowly classical.

method of teaching the classic languages[1], and is by no means either dull or stupid under a more rational regime. In technical matters such students often distinguish themselves. For secondary commercial education the classic languages are of less value than the modern languages, and hence the pupil ought not to be forced to learn the former if he prefer to do otherwise.

The three practical methods of establishing sound secondary commercial education are the following :—

(1) The formation of independent commercial schools.

(2) The formation of a thoroughly organised commercial school within a secondary school.

(3) The addition of what are called *elective* commercial subjects in the ordinary secondary curriculum.

Touching the last method, viz. (3), it may be stated that about eleven years ago the Chairman of an American "committee of ten" expressed the opinion that "all the commercial instruction required for high schools can be furnished by the introduction of elective courses into schools already existing." Later on, however, he completely abandoned such an opinion, holding, as the result of riper experience, that such elective commercial studies led to inferior commercial training[2]. This is important by way of rejoinder to proposals, which are sure to come about, to establish what will be called commercial sections in secondary schools without proper consideration as to their commercial efficiency as the curricula. We need to be careful in this matter, because it is easy to deceive or be deceived in regard thereto. It may appear to be a mere truism to say that a genuine school is not constituted by writing a name over its portals, nor is a section within it made genuinely "commercial" by teaching a little book-keeping, typewriting, or shorthand. For this reason a number of curricula are given, and be it said that these are not mere affectations of curricula.

3. *The Curriculum of the Committee of Nine.*—The Committee has been referred to hereinbefore. After a lengthy discussion this body drafted a four-year course for secondary commercial education. It deemed the creation of separately organised commercial schools was advisable, but believed that in many cases the curriculum would only be established as one of the several courses which would be established in public high schools.

The curriculum runs as follows[3] :—

1st Year.		
Subjects.	Sem. I.	Sem. II.
English	4	4
German, or French, or Spanish ...	5	5
Algebra	5	5
Book-keeping	3	3
Drawing	3	...
Penmanship	3	2
General History to A.D. 800	...	4
	23	23

2nd Year.		
Subjects.	Sem. I.	Sem. II.
History of English Literature, Composition	3	...
History of English Literature, Commercial Correspondence	...	3
Modern Language	5	5
Commercial Arithmetic	5	...
,, Geography	...	5
Book-keeping	5	...
Typewriting	...	5
Commercial Products or Local History and Industries	5	...
English and European History ...	...	5
	23	23

[1] Professor Sadler, the erstwhile editor, and contributor to the "Special Reports" states that in England commercial education means quite as much an angry cry of *protest against misplaced and mechanical classical education* as it does a desire to have some definite policy carried out.

President Charles W Eliot, in Proceedings International Commercial Congress of 1899.

[3] Proc. Nat. Educ. Assoc. Boston, 1903, pp., 750-752. See also Proc., 1904.

3rd

3rd Year. Subjects.	Sem. I.	Sem. II.	4th Year. Subjects.	Sem. I.	Sem. II.
Rhetoric and Composition	3	...	English Literature, Themes, Parliamentary Practice	5	5
Plane Geometry	...	5	History of Commerce	5	...
Physics or Chemistry	5	5	Civil Government	...	5
Political Economy	5	...	Elective Subjects as explained hereunder	15	15
Commercial Law...	...	4			
Book-keeping and Office Practice ...	5	...			
First Language, or Second Modern Language, or Shorthand and Typewriting	5	5			
United States History	...	4			
	23	23		25	25

The electives are 15 periods, to be selected from among the following:—

1st Semester of 4th Year.		*2nd Semester of 4th Year.*	
Language, elected, or Shorthand and Typewriting continued	5	Same election, continued	5
Physics or Chemistry	5	Physics or Chemistry, continued	5
Banking and Finance	5	Accounting, Organisation, and Auditing ...	5
Solid Geometry	5	Advanced Commercial Arithmetic	5
Mechanical Drawing	5	Advertising, Study of Trade Journals, Commercial English	5

These "periods" are 45 minutes duration each; hence the totals represent about $17\frac{1}{4}$ hours each. This amount of "recitation" was regarded as somewhat long, and will perhaps be slightly modified this year.

4. *The New York High School of Commerce.*—The High School of Commerce in New York is housed in a fine building, is well equipped, and may be taken as a representative secondary school. Its curriculum is as hereunder[1] :—

Subjects.	Years—Hours per week. I.	II.	III.	IV.	V.
Obligatory.					
English	4	3	3	3	3
German, or French, or Spanish ...	4	4	4	4	...
Algebra I, Geometry II	4	3	...	...	...
Algebra and Geometry	...	...	3	...	...
Chemistry (referring to materials of commerce)	...	4	...	...	...
Biology and Physiology (commercial)[2]	4	...	...	...	...
Physics	...	...	5	...	...
Greek and Roman History	2	...	...	...	...
Mediæval and Modern History, refering to Economic History and Geography	...	3	3[3]	4[4]	...
Business Writing	4[5]	...	...	...	...
Stenography	2[6]	2	...	...	...
Drawing	2	2	...	...	.
Physical Training (including Physiology)	2	2	2	2	2
Music	1	...	...	...	...
Economics and Economic Geography ...	...	...	...	4	...

Subjects.	Years—Hours per week. I.	II.	III.	IV.	V.
Elective.					
Business Arithmetic	1	...	...	...	...
Commercial and Economic Geography	1	...	...	...	4
German, or French, or Spanish ...	...	4	4	4	...
Business Forms, Book-keeping ...	...	3	4[7]	...	...
Music	...	1	...	...	...
Stenography and Typewriting ...	...	...	3	4	...
Drawing	...	...	2	2	3
A Third Language	...	...	...	4	4
Advanced Chemistry	...	...	...	4	4[8]
Trigonometry and Solid Geometry ...	...	...	...	4	...
Elementary Law and Commercial Law	...	..	...	4	...
Business Correspondence, Office Practice	...	...	...	4	...
Advanced Mathematics	...	...	...	...	4
Advanced Physics	...	...	...	...	4
Recent and Diplomatic History ...	...	...	...	...	4
Banking, Finance, Transportation, Routes of Communication, etc.	...	...	...	...	4
Administrative and International Law	...	...	...	...	4
Accounting and Auditing	...	...	...	...	4
Business Organisation and Management.	...	...	...	...	4
Economics (advanced)	...	...	...	...	3

The above curriculum is clearly a comprehensive one, and allows a large number of elective or optional subjects, without apparently losing efficiency.

Other examples of American programmes are given in the Report. [See Chap. LXII, pp. 847-853.]

[1] According to the "Year Book" of 1903.
[2] That is, specially referring to commercial commodities.
[3] In the third year English history similarly orientated.
[4] Refers specially to industrial and constitutional aspects of United States history.
[5] First half year only.
[6] Second half year only.
[7] With Commercial Arithmetic.
[8] Industrial Chemistry.

5. *Secondary Commercial Education, Argentine Republic.*—Since the Argentine Republic pays more per pupil and per inhabitant for even primary education than does New South Wales[1], her idea of secondary commercial education may be viewed as of interest. This idea may be regarded as represented in the curriculum of the *National School of Commerce* in Buenos Ayres. The curriculum runs as follows:—

Subjects.	Years. I.	II.	III.	Subjects.	Years. I.	II.	III.
Review Arithmetic: Algebra	4	...	...	English	5	5	5
Spanish, Commercial Correspondence ...	5	3	3	French	5	5	5
Book-keeping, Office Practice	6	6	7	Commercial Products ...	...	3	3
Commercial Geography, History Commerce	3	3	...	Political Economy, Commercial Law	...	2	...
Penmanship, Shorthand and Typewriting	2	3	3	Custom House Procedure	...	...	4
				Total	30	30	30

The minimum age of entrance is 14, and the candidate must *inter alia* have studied, for at least two years, geography, history, arithmetic, Spanish, English, and French. The diploma issued is "Mercantile Expert."

6. *Secondary Commercial Education in Belgium.*—In Belgium, commercial education is an integral part of the State system. Some time ago the upper division of the *Colleges* had three collateral branches each with a two years' course, viz., (i) Commerce, (ii) Industry, (iii) Science; but in 1881 the system was wholly revolutionised. [Rept. Sec. Educ. XI, secs. 1–20, pp. 126–136.] The programmes are given in the Report on Secondary Education [*See* sec. 6, p. 130, for the Modern Humanities section with Commercial Science], in which also the details of the course are given. [*See* secs. 14–19, pp. 134–136.]

The following is translated from the *Programme des cours de l'Athénée Royal de Bruxelles,* 1902. The work commences in the 5th class, when the pupil is 13 or 14 years of age.

Fifth Class.—Agents and institutions in connection with internal commerce. Invoices, accounts of purchases and sales. Way-bills. Commercial correspondence.

Fourth Class.—Recapitulation of preceding course. Principal duties of a merchant, according to the code. Exchange notes. Promissory notes. Book-keeping by single entry. Auxiliary books. General theory of book-keeping by double entry. Commercial correspondence. Exercises by way of applying the preceding.

Third Class.—Repetition of principal parts of preceding course. Agents, etc., in connection with foreign trade. Subdivision of general accounts. Special accountancy. Consignees, traders, bankers, partners in a company. General ideas as to commercial law, especially referring to consignment and companies. Current accounts, and interests, according to the three methods. Annuity accounts. Commercial correspondence. Application exercises.

Second Class—Commerce.—Principles of acconntancy, arbitration, currency, etc.

Commercial law.—Elementary notions concerning civil law as regards contracts or conventional obligations, sale, drafts. Elements of commercial law. *History of industry and commerce in Belgium.* Rapid glance at the state of commerce and industry before the Roman domination. Charlemagne. Norman invasion. Influence of the Crusades. The Hansa in Belgium. Markets. Influence of communes. County of Flanders, of Hainaut, Duchy of Brabant, Principality of Liége from 13th to 14th century. The House of Burgundy.

Industrial and Commercial Geography of Belgium.—Study of the nine provinces, nature of soil, principal natural and industrial productions, commerce, roads and railways, remarkable localities.

Rhetoric Class—Commerce.—Recapitulation. Public Funds. Actions and obligations. Methods of repayment of loans. Operations on change. Life assurance and insurance of goods. Ordinary and savings banks. Partnership accounts, speculation, net costs.

Commercial Law.—Law of bankruptcy, etc. Commercial tribunals. Councils of experts. Principal common laws, patents, warrants, trade-marks.

Political Economy.—Production and its factors. Favourable conditions of production (machines, property, liberty to work, division of labour, association, instruction). Exchange and markets. Money. Instruments and institution of credit. Division of Wealth. Consumption and saving. Luxury. Taxes. The Budget. Population. Elements of theoretical and practical statistics.

History of Commerce and Industry in Belgium from 15th century to the present time.—Aperçu of the development of the most important industries.

Industrial and Commercial Geography of Belgium.—The foreign trade of Belgium. Countries providing principal imports, etc.

Remembering that the mathematical and scientific part of the course well supports the above, it is evident that the Belgian system is a good type of the method of combining the work with that of the High School. 7.

[1] The cost of education in New South Wales is thought by those who fail to grasp the significance of modern education to be excessive.

7. *The Finnish Commercial Institute.*—The programme of the Commercial School in the capital of Finland, the *Handelsinstitutet i Helsingfors,* discloses nothing calling for special remark [Chap. LIX, sec. 2, p. 808]. Its development is very similar to that of other commercial secondary schools. It has a preparatory course of one year, followed by a definite two-years' course.

8. *Secondary Commercial Education in Germany.*—The public Commercial School (*Oeffentliche Handelslehranstalt*) of Leipzig may be taken as an example of the secondary commercial school of Germany. It was founded in 1830 by the Trade Schools' Guild, and taken over by the Chamber of Commerce in 1888. It has about 800 students.

Its programme is as follows :—

Subjects.	Years.			Subjects.	Years.		
	I.	II.	III.		I.	II.	III.
Obligatory.				*Obligatory—continued.*			
German	4	3	3	Commercial Bureau, Correspondence, Bookkeeping	...	3	3
English, with Correspondence ...	5	4	5	Economics	...	...	2
French „ „ ...	5	4	5	Caligraphy	2	2	...
Mathematics	3	3	4	Shorthand	2	1	1
Commercial Arithmetic	5	3	2	Gymnastics	2	2	2
Physics	2	2	...				
General Technology	...	...	2				
Chemistry	...	2	2				
Commercial Commodities	...	...	1	*Optional.*			
General and Commercial Geography .	2	2	2				
„ „ „ History ...	2	2	2	Italian	...	2	2
Commerce, its Laws, Exchange Laws ...	...	2	1	Spanish	...	...	2

It may be worthy of mention that the total expenses of the school are about £7,000 per annum, of which about £4,000 to £5,000 is met by students' fees. Schools of this type are not so much vocational as educational. Dr. Adler states it is not intended that the work of the school shall take the place of practical experience in business, but that it shall make such experience more fruitful. The commercial schools do not propose to be substitutes for practical training, but rather to prepare for the commercial career. It has all the thoroughness of organisation of the German educational method.

9. *Scheme of Secondary Commercial Schools, Holland.*—In Amsterdam and Rotterdam the Higher Burgher Schools have a commercial section. *Gemeentelijke hoogere burgerschool met handelsschool*). The better organised was the one at Amsterdam, in which the subjects were as hereunder, viz. : —

Languages.		*Commercial Subjects.*		
Dutch.	Spanish.	Commercial Geography.	Merchandise.	Book-keeping.
French.	Italian.	History of Commerce.	Commercial Chemistry.	Accountancy.
German.	Swedish.	Commercial Arithmetic,	Political Economy.	Caligraphy.
English.	Malay.	Commercial Mathematics.	Commercial Law.	Stenography.

For further information, the body of the report may be consulted. [Chap. LIX, sec. 3, pp. 808–9.]

The *Esmeyer Commercial School* of Rotterdam has a five-year curriculum, the age of entry being about 13. The subject of study are :—

Caligraphy.	Italian or Spanish.	Sacred History.	Constitutional Law.
Stenography.	Arithmetic.	National History.	Commercial Law.
Dutch.	Algebra.	Universal History.	Political and Social Economy.
French.	Geometry.	Commercial History,	Freehand Drawing.
English.	Commercial Arithmetic.	Geography.	Gymnastics.
German.	Book-keeping.	Natural Science.	

[Chap. LIX, sec. 4, p. 809.]

10.

10. *Hungarian and Italian Secondary Commercial Schools.*—Some of the higher primary schools of *Hungary* have annexed commercial schools of three classes, the special subjects in which are Commercial Arithmetic, Book-keeping, Commercial Correspondence, Merchandise and Technology, Exchange Law, and Industrial Law, Political Economy, Practical work (Counting-house). [See Chap. LVIII, sec. 2, p. 794.] The whole scheme of Hungarian commercial education is explained in the body of the report.

A large number of the technical institutes of *Italy* ("*istituti tecnici*") have a commercial and accountancy section ("*Sezione di commercio e ragioneria*); for example, the "Caio Plinio II" at Como, the "Galileo Galilei" at Florence, the "Vittorio Emanuele II" at Genoa, the "Carlo Cattaneo" at Milan, the "Giovanni Battista della Porta" of Naples, the "Leonardo da Vinci" at Rome, the "Paolo Sarpi" at Venice, and many others.

The course is of four years duration, the subjects being:—

Caligraphy.	Ornamental Drawing.	French Language.
General Chemistry.	Political Economy.	English or German Language.
Accountancy and Book-keeping.	Financial Science and Statistics.	Mathematics.
Civil Law.	General Physics.	Zoology and Botany.
Commercial and Administrative Law.	Geography.	Mineralogy and Geology.
	Italian Literature.	General History.

Formerly Logic and Ethics were included, but these subjects have been deleted. [Chap. LIX, secs. 8, 9, pp. 810–1.]

11. *Secondary Commercial Education in Russia and Switzerland.*—The organisation of *Russian* commercial education of the secondary grade was dealt with in the Report on Secondary Education [Rept., Sec. Educ., Chap. XXVI, secs. 5, 6, pp. 309–311]. The Russian "Realschool," of six classes, has for the last two years an ordinary and a commercial division.

The *School of Commerce*, of seven classes, has a somewhat lengthy programme, the subjects being:—

Religion.	Geometry and Trigonometry.	Drawing.	Correspondence.
Russian.	Geography.	Chemistry.	Commercial Geography.
German.	History.	Merchandise.	Political Economy, Law.
French.	Natural History.	Commercial Arithmetic.	Experiments: Chemical, and on Merchandise.
Arithmetic.	Physics.	Bookkeeping.	
Algebra.			

Obviously it is comprehensive, and it may be said that the work is thoroughly done.

The Report gives several illustrative examples of the organisation of Secondary Commercial Education in *Switzerland.* The Commercial School of the Municipal Gymnasium of Berne (Handelsschule des städtischen Gymnasiums) takes pupils of not less than 14 years of age, and has a four-year course, the following being the subjects of the curriculum, viz.:—

Religion (optional).	Accountancy and Counting-house practice.	Physics.
German.	Theory of Commerce and Commercial Law.	Chemistry, Technology, Study of Merchandise.
French.	Political Economy.	Drawing.
English.	Geography and Statistics.	Caligraphy and Stenography.
Italian.	History.	Gymnastics.
Mathematics and Political Arithmetic.	Natural Sciences.	Singing (optional).
Commercial Arithmetic.		

That the course is a good one may be seen from the lengthy outline of the treatment of each subject: this is given in the Report [Chap. LX, secs. 7, 8, pp. 821–2].

Another

Another example which may be referred to is the Commercial School of the Winterthur "Technicum."

Subjects.	Years.						Subjects.	Years.					
	I.	II.	III.	IV.	V.	VI.		I.	II.	III	IV.	V.	VI.
German	3	3	3	3	3	3	History of Commerce and Civilisation	2	2	2	...	...	...
French	4	4	4	4	4	4	Physics	3	3	...	...	...	...
English	4	4	4	4	4	4	Chemistry	3	3	...	...	...	...
Italian	3	4	4	4	4	4	Caligraphy	2	2	...	...	...	...
Spanish (optional)	...	...	(2)	(2)	(2)	(2)	Stenography	2	1	...	...	...	...
Conversation on Economics	...	...	...	...	2	2	Law of Exchange and Commercial Law	...	...	2	2	2	...
Accountancy, Book-keeping	4	4	4	4	...	...	Commercial Geography	...	...	2	2	2	2
Economics	...	..	2	2	...	...	Merchandise	...	...	2	2	...	...
Customs	...	...	...	...	...	2	Insurance	...	...	...	...	2	2
Arithmetic of Economics ...	..	...	2	2	...	...	Post and Railway Tariffs	...	...	...	...	2	...
Algebra	2	2	...	...	...	...	Laboratory Practice	...	...	...	...	2	3
Geography	2	2	...	...	...	...	Commercial Bureau	...	...	...	3	5	5

The complete outline of the subjects of this excellent course is also given in the report. [Chap. LX, secs. 20, 21, pp. 831–3].

12. *Secondary Commercial Education in England.*—There has been a growing recognition in England that the failure to provide good commercial education is, more than a "class" matter—that it is a question of practical political moment.[1] It may be mentioned that Professor James, as late as 1893, stated that higher commercial instruction in England did not exist; and our own countryman, Sir H. Trueman Wood, said much the same thing in 1899. English Consular Reports are stated to have given "a most alarming recital of the failure of English merchants through lack of preparation." English education has been classical in its spirit and emphasis[2] and essentially individualistic; and, according to Mr. James Bryce, by a wide survey it may be recognised that, owing to deficiencies in English secondary education,[3] the commercial classes have not attained that relative position of wealth and greatness which England herself occupies. "The classics are fashionable," it has been said; education for business is not . . . . We are still playing at school, like children in a nursery.[4]

English educationists and publicists recognise the serious need of changing all this. The London Chamber of Commerce held a conference in 1870 and another in 1885. Following the prevailing English instinct, it instituted a system of *examinations*, an account of which is given in this report [Chap. LI, secs. 10–17, pp. 731–8], as a result of its perception of the pressing urgency of commercial education.

This disposition to hold examinations, instead of creating well-equipped schools with thoroughly trained teaching staffs, appears to be the particular form of *educational disease* to which we are prone.

A committee of the London County Council[5] decided "that it was desirable that there should be provided, in at least one public secondary day school of the first grade, a department *devoting itself primarily and avowedly to the preparation for business life* of boys leaving school at 18 or 19." The *London Journal of Education*[6] commented on the abandonment of the educationally unsound notion of regarding examinations in commercial subjects as a sufficient stimulus for commercial education.

As an outcome of the consideration of the whole matter, a "*Commercial Department*" and a "*Higher Commercial Department*" have been developed in the University College School, London, in Gower-street. Mr. Augustus Kahn, who had

[1] This was the expressed view of the Duke of Devonshire.
[2] "Meaning and Practice of Commercial Education." C. A. Herrick, 1904, p. 132.
[3] Introduction to "Studies in Secondary Education," p. 28.
[4] Magazine for Commerce. Dec. 1902.
[5] See Proc. of the Conference on Commercial Education," July, 1898. Waterloo & Sons, London, 1898 (94 pp.); also "Summary of the Commercial Education Conference of July 8, 1898, (a supplement to the proceeding)," 4 pp.
[6] August, 1898.

had some experience of commercial schools in Europe, is in charge of these. He has emphasised the *study of modern languages*[1] as an essential feature of any commercial education that is to enable the British nation to hold its own commercially.[2]

The curriculum is outlined in the report. [Chap. L., pp. 720–722, by Mr. J. W. Turner.] It will be found to be the nearest approach to the secondary school of commerce of the United States. It may be pointed out, however, that at the time of the Commissioner's visit its equipment for any scientific or commercial teaching was very poor indeed as compared with schools of the same importance in any part of Europe. The "classic" influence expresses itself by a disregard for material aids to instruction. In the English scheme of instruction in the dead languages, little or no apparatus is used; the grammar, delectus, and author are all that are required. And since the domination of the English school education has been literary, the natural history and natural science equipments, and all material for intuitional instruction, are either very meagre, or conspicuous by their absence. This influence was very evident at the time of the Commissioner's visit, and the London University College School at that time was by no means equipped comparably to the Continental schools.[3]

"England has no well-organised system of secondary commercial education," is the verdict of Dr. C. A. Herrick,[4] and also of Dr. Carl Peters, and the judgment of the Commissioner was coincident therewith.

There are a number of *examining* bodies for commercial subjects besides the London Chamber of Commerce—for example, the Society of Arts, the Institute of Actuaries, the Institute of Chartered Accountants and Auditors, the Institute of Bankers, etc.

The Evening Schools of the West Riding of Yorkshire are elementary.

Among what have been called "*private adventure*" schools, may be mentioned the *Pitman Metropolitan School*,[5] which, however, is merely of the type of the private business schools, colleges, or academies found in the United States.

13. *General remarks.*—Just as higher commercial education, organised best of all in Special Higher Schools of Commerce, or in Universities, is essential for the creation of a *corps d' élite* among commercial men, and for the training of commercial teachers, so is secondary commercial education an essential for the training of those engaged in all responsible posts of commercial institutions.

And if all countries, without exception, have found it necessary to provide *properly organised secondary commercial education*, then it seems difficult to assign any reason why we should not make the necessary opportunity for similar training for the youth of the State. For guidance, we cannot accept the example of any country which substitutes examinations for teaching; a scheme which, from an educational point of view, accentuates the evils of cramming and has absolutely nothing to commend it. No one can see the well-organised, thoroughly equipped, ably and specially staffed secondary commercial schools of Continental Europe without recognising that they afford the only type of commercial education that is worthy of the name.

---

[1] See paper on Commercial Education in Secondary Schools, *London Educational Times*, May, 1900.
[2] Mr. Kahn was the winner of a travelling scholarship, and he investigated commercial education in Europe. It may be mentioned that we have prominent men sufficiently provincial and limited in their ideas as to imagine that it is sufficient for the foreigner to learn English. Such an opinion is exceedingly injurious—perhaps even dangerous.
[3] Whether the College School has since been properly equipped is not known to the Commissioner.
[4] *Op. cit.*, p. 161.
[5] Founded 1870, to teach Shorthand; has about 1,500 students.

XVII.

ELEMENTARY COMMERCIAL EDUCATION AND COURSES IN COMMERCIAL SUBJECTS.

[G. H. KNIBBS.]

1. *The Nature of Elementary Commercial Education.*—In Division XIV, sec. 7, of this summary it is stated that elementary commercial education is provided in schools of the type (5), (6), and (7), viz., in elementary day or evening schools, and in schools of various classes giving courses in commercial subjects. It is mentioned also that general instruction may be orientated with special reference to commerce, as it may with reference to other subjects.

In dealing with the lower planes of *commercial education,* it is well to again consider its nature. To some the term implies what has been well called the "narrow technical work of the business college stamp." To others it means "that form of general education which prepares" for intelligent "apprenticeship in business pursuits." Commercial education, it has been stated, is of three kinds—trade, professional, and academic; the vocational element predominating in the first in the narrowest technical sense, predominating also, but in a liberal form, in the second, and being subordinated to the academic and cultural element in the third. The first, however, is instruction in commercial subjects rather than commercial education in the broader sense.

Schools in which a modicum of instruction in penmanship (caligraphy, as it is called in Europe[1]), shorthand, typewriting, book-keeping, etc., are given, are hardly constituted thereby schools for commercial *education.* The distinction is important, as is well recognised by all educationists. A school becomes a school for commercial education when the special subjects are properly organised, treated liberally, and so correlated with other subjects as to prevent them being *narrowly technical.* Just as manual training is not merely carpentry, etc., so also commercial education is not merely instruction in practical typewriting, stenography, and so on.

2. *Types of Elementary Commercial Instruction.*—The various forms of elementary commercial instruction observed were the following, viz. :—

(1) Independent courses in various commercial subjects in day or evening schools.
(2) Day or evening schools for specialised courses of elementary commercial instruction.
(3) Day schools with combined, general, and commercial education, systematically developed.
(4) Continuation or evening schools with organised commercial courses.
(5) Commercial departments of a lower grade or branches of higher primary and secondary schools for general education.
(6) Elementary commercial instruction in primary schools.

The last is the most questionable form of commercial instruction from an educational point of view, for the technical elements in primary schools must be liberal and educative, *i.e.*, cultural, not vocational.

Examples of these various types, as they exist in various countries, and, also, several independent commercial courses, will be referred to.

3.

[1] Fr. Calligraphie, Ger. Schönschreiben or Kalligraphie

3. *Elementary Commercial Instruction and Commercial Courses in America.*—The commercial and business colleges of America are very variously organised. There are business colleges which simulate real business; where, without any theoretical instruction, the student starts with his business stationery, and a capital of $5,000 (say £1,000); he banks this, pays his rent by drawing a cheque in favour of the "real-estate agent," and then buys "bills of merchandise for cash." The merchandise bought on the first bill is sold to two separate students for cash. He makes the proper entries, after a little while discontinues transactions till after posting and making a trial balance, and so on. This method has its supporters.[1]

Some of the business colleges, for example, the Public School of Philadelphia, have what they call full courses in (a) business, (b) stenography and typing, and (c) English, organised as follows, viz. :—

Business Course.—Book-keeping, caligraphy, commercial and rapid arithmetic, business correspondence, mercantile forms and customs, banking, finance, economics, civics and business ethics, commercial geography and commercial law.

Stenography Course.—Stenography, typing, business forms and customs, civics, business ethics, and English; *i.e.*, spelling, use of words, grammar, punctuation, synonyms, etymology, and business correspondence.

English Course.—Practical training in arithmetic, spelling, etc., grammar and composition, caligraphy, business correspondence, geography, etc.

Another college, viz., Duff's College, Pittsburg, has a course embracing theory and practice of single and double entry; mercantile, national and private banking; railroad, manufacturing, insurance and commercial calculations, and arithmetical training; rapid practical penmanship, business forms, letter-writing, orthography and language lessons; lectures on mercantile law, commercial ethics, and political economy.

A good example of organised elementary commercial instruction is given in the two-year course referred to in the Report [Chap. XLII, pp. 848–9, by Mr. J. W. Turner]. This is the commercial school of San Francisco, under their Public Instruction Department.

Another type of commercial education altogether is that provided by the *Drexel Institute* of Philadelphia, a private endowed institution, independent, practically, of students' fees. This has courses of the following character, viz.:—

(1) Commerce and finance; (2) commercial course for teachers; (3) office courses; (4) evening courses.

The aim of (1) is to prepare for business of the following character, viz.:—

(a) Production, manufacture, sale and transportation of articles of commerce.
(b) Management of stock companies, corporations, etc.
(c) Buying and selling of securities.
(d) Importing and exporting merchandise.
(e) Borrowing and lending money, and credit.
(f) Advertising commercial concerns.
(g) Keeping business records.
(h) Knowledge of Spanish language.

The office courses (3) are:—(a) private secretary course; (b) book-keeping course; and (c) stenography course [loc. cit. pp. 849–853].

The course (1) is more liberal than the class of work done in the "business colleges," but it can hardly be called either secondary or elementary business education, it is really *technical*; the other courses are still more narrowly technical. Still

[1] See Proc. Nat. Educ. Assoc. 1899, pp. 1002–1007. Mr. P. J. Hartog mentions a caricature of this by R. L. Stevenson and Lloyd Osbourne in *The Wrecker*, pp. 16–19.

Still another type of college is the *Simmons' College* of *Boston,* for commercially educating women. It has a four-years course, following on high-school graduation. The curriculum is as follows:—

Subjects.	Years.				Subjects.	Years.			
	I.	II.	III.	IV.		I.	II.	III.	IV.
English	3	3	2	2	Hygiene	1	...	...	...
French, German, or Spanish ...	6	6	...	...	Library Economy	...	...	3	...
History	3	3	...	...	Secretarial Subjects	...	...	2	5
Shorthand and Typewriting ...	3	3	2	2	Business Law	...	...	...	3
Physical Training	2	2	2	2	Various Elective Subjects ...	..	...	6	3

Examples could be multiplied, but would serve no useful purpose. It is sufficient to observe that the advocacy for the narrowly technical view appears to be declining, that commercial subjects are yearly being more educatively handled[1], and that there is increasing confidence in the more liberal forms of instruction.

4. *Elementary Commercial Education in Austria and Hungary.*—Elementary commercial courses are given in *Austria,* in what may be called the Mercantile Continuation School (*Kaufmännische Fortbildungsschule*). The curricula of two taken at random are given. They are both three-year schools. The third example is for a mercantile course (*Handelskurs*) for girls:—

Subject.	Aussig.			Olmütz.			Aussig (Girls).
	I.	II.	III.	I.	II.	III.	I.
German	2	1	...	2	...	...	...
Commercial Geography	1	2	...	1	1	1	2
Commercial Arithmetic	2	2	2	2	2	1	4
Book-keeping	...	...	...	...	1	2	4
Commercial Correspondence	...	1	1				
Counting-house Practice	...	...	...	...	...	1	4
Theory Commerce and Exchange	...	1	1	...	...	...	2
Caligraphy	2	...	...	1	1	...	2
Stenography	...	...	...	...	...	...	3

Austria has about 135 of such schools, with a total attendance of about 22,000. [Chap. LIV., secs. 6, 7, 9, pp. 752–755.]

In *Hungary* there are special schools for commercial apprentices. These have developed from a Sunday morning school, established as far back as 1830. In 1868 it was enacted by law that no apprentice could engage in a commercial occupation until 12 years of age, and had passed through the six classes of the primary school. The apprentice employed commercially at that age must, for three years more, attend some continuation school[2], or the commercial apprentice school. The provisions of the law determine the minimum function of the apprentice-school. These provisions were modified in 1872, 1884, and 1885.

The law of 1884 concerning industries also regulated the régime of all the apprentice-schools, and gave a definitive form to the schools for commercial apprentices. It necessitated the modification of the earlier provisions, the regulations of 1893, and later those of 1897, at present in force, were developed under it. [Chap. LVIII, sec. 24, pp. 803–4.]

The

[1] See the work of the Department of Business Education of the National Educational Association. For example, Proc. 1903, pp. 719–752; Proc. 1904, pp. 709–736.

[2] Compulsory attendance at a continuation school is very common in German towns and cities.

The programme of studies is as follows :—

Subjects.	Years. Preparatory.	I.	II.	III.
Reading, redaction, object-lessons	4	2	2	1
Geography, commercially orientated	...	1	1	...
Commercial arithmetic and counting-house work ...	2	2	2	2
Book-keeping and accountancy	...	1	1	2
Bills of exchange, correspondence, etc.	...	...	...	2
Caligraphy	1	1	1	...

The age of entrance is 12 years at least, and pupils who have not the primary school certificates must enter the preparatory class.

Where the number of pupils are insufficient to establish a commercial apprentice school, the instruction is given as a section in an industrial apprentice school. A certificate is issued at the end of the course.

The report contains a fairly complete statement of the whole organisation of these schools, which are attended by about 9,000 pupils annually. There are now not less than 90 of the independent schools for commercial apprentices. [Chap. LVIII, secs. 24-27, pp. 803-5.]

The Hungarian courses for young women are two-year courses, and the services of certificated students are in demand. [Secs. 28-33, pp. 805-7.] The programme is as follows :—

Subjects.	Years. I.	II.	Subjects.	Years. I.	II.
Commercial arithmetic	4	2	Counting-house work, correspondence in Hungarian ...	2	2
Book-keeping	2	4	,, ,, ,, in German ...	2	2
Bills of exchange and ideas of commerce.	2	2	Description of merchandise, commercial geography ...	2	2
			Caligraphy	1	1

The feature of commercial education in Hungary is the accentuation of the primary form. There is a growing opinion that the highest form has not been sufficiently developed.

There are *courses for commercial teachers* in Hungary [*see* Chap. LVIII, sec. 21, pp. 802-3], it being well recognised that the training of the teachers is of fundamental importance.

5. *Elementary Commercial Education in France.*—Reference is made in the Report to Elementary commercial education of France [chap. LIV, secs. 10-15, pp. 755-7]. This is given in three classes of school, viz., the practical school of commerce for youths or young women (*école pratique de commerce, garçons ou filles*), and the commercial side of the practical school of commerce and industry (*école pratique de commerce et d'industrie*).

The title " higher primary commercial school for boys "[1] was first given to one of these schools, though afterwards it was called " practical school of commerce," and, as such, placed under the Minister of Commerce. The course is of three years duration.

These schools have the following staff, viz. :—

(1) A *director*, charged with the instruction in the physical and natural sciences, and with the technology of merchandise.

(2) A teacher charged with instruction in book-keeping, etc., legislation, and the operations in the commercial bureau.

(3) A teacher of mathematics, writing, and drawing.

(4) A teacher of French, history, and geography.

(5) A teacher of English.

The

[1] *Ecole primaire supérieure commerciale de garçons.*

The programmes of these schools are by no means identical for the two sexes, as is obvious from the following example :—

	Youths—Years.			Young Women—Years.		
	I.	II.	III.	I.	II.	III.
Commercial Instruction.						
Commerce, Accountancy, and Book-keeping ...	6	6	6	4½	4½	4½
A foreign-language	6	6	6	4½	4½	4½
Arithmetic and Algebra...	3	3	3	3	3	3
Geography	1½	3	3	1½	3	3
Writing and Caligraphy...	3	1½	1½	3	1½	1½
Chemistry and Merchandise	1½	3	3	...	1½	1½
Legislation	...	...	3	...	...	3
Commercial Economy	...	...	1½	...	...	1½
General Instruction.						
French	4½	3	3	4½	3	3
Drawing	1½	1½	1½	1½	1½	1½
History	1½	1½	...	1½	1½	1½
Natural History and Hygiene	...	1½	...	...	1½	...
Geometry...	...	1½	1½	...	1½	1½
Notions of Physics	1½	...	...	1½	...	...
Ethics	...	...	...	...	1½	1½
Domestic Economy	...	...	...	...	...	1½
Ordinary Sewing and Cutting-out	...	...	...	3	3	3
Studies	9	9	9	4½	4½	3

These courses are also those of the commercial side of the schools of both commerce and industry.

In the educational establishment of the "Legion of Honour" (*maisons d'éducation de la Légion d'honneur*) for the education of the daughters of members, the course in the commercial section, the duration of which is one year, is as follows, viz. :—

Subjects.	Hours per week.	Subjects.	Hours per week.	Subjects.	Hours per week.
Accountancy... ..	7	Commercial correspondence..	2	Typewriting	5
Commercial Law ...	1	" arithmetic ...	1	Caligraphy	2
Foreign languages ...	9	Stenography...	4	Commercial geography...	2

Such a course is evidently purely vocational, though liberally so. So also is the course in some of the *écoles pratiques*. For example, in the *école pratique de commerce et d'industrie de Rouen*, the course is of two years duration only, and is organised as follows, viz. :—

Subjects.	Years. I.	Years. II.	Subject.	Years. I.	Years. II.
Commerce, Accountancy, Book-keeping	4	4	Technology of Merchandise ..	1	1
English	5	5	Commercial Legislation	1	1
Arithmetic and Algebra	1½	1½	Commercial Economy	...	1
Economic Geography	1½	1½	Commercial Redaction	2	1
Writing and Stenography	2	2	Studies	2	2

This also is a professional course.

There

There are also evening courses, some of them *gratuitous*, as for example those of the Society for the protection of Commerce, at Marseilles.[1] These include the following subjects, viz.:—

Subjects.	Years. I.	Years. II.	Subject.	Years. I.	Years. II.	Subject.	Years. I.	Years. II.
Commercial Correspondence ...	1	...	Stenography ...	1	1	Spanish	1½	1
Commercial Bureau	1	...	French	1	...	Italian	1½	1
Caligraphy	2	...	English	2	1	Commercial Law ...	1	...
Accountancy	1½	1	German	2	1			

Commercial courses are also given by the " Popular Institute of Commercial Instruction.[2] These include modern languages, commercial accountancy, and stenography.

A considerable number of bursaries are available for students of limited means.

6. *Elementary Commercial Education in Germany.*—The lower grade of commercial education is largely provided for in special " Mercantile Continuation Schools" (*Kaufmännische Fortbildungsschulen*) and also in general continuation schools, with commercial instruction. In Berlin, for example, there is one Gymnasium, one Realgymnasium, and two " Real " schools (four in all)[3] where such subjects as the following are taught in the evenings, viz.:—Modern languages, commercial arithmetic, book-keeping, stenography, typewriting, caligraphy, commercial correspondence, and technology of merchandise, besides mathematics, physics, etc. [Chap. VI, secs. 2, 3, pp. 30–31.] Besides these there are thirteen municipal continuation schools for young people,[4] where one finds taught such subjects as commercial calculations, book-keeping, typewriting, stenography, caligraphy, theory of exchange, modern languages, &c.; in fact most of those are taught in each of the thirteen schools. [Sec. 4, p. 31.]

The *Trades Union* has a continuation school[5] also, with three branches of instruction, viz.—(1) Elementary; (2) Commercial-industrial; (3) Technical. In the second section one finds the following subjects taught, viz.:—

American book-keeping, book-keeping by double entry, by single entry, the theory of exchange, commercial calculations, commercial correspondence, French and English, stenography and caligraphy. Both sexes are admitted. [Sec. 5, pp. 31–2.]

The Chamber of Commerce (*Korporation der Kauffmännschaft*) of Berlin has a series of commercial continuation schools. These are held in the buildings of three Gymmasiums, one Realgymnasium, and two " Real " schools, six in all. In these one finds such subjects as the following, viz.:—

The mother-tongue, such modern languages as English, French, Spanish, Russian, economics, the theory of commerce and exchange, book-keeping by single and by double entry, commercial correspondence, counting-house practice, stenography, typewriting, commercial arithmetic, commercial method, commercial law, technology of merchandise, etc. [Sec. 6, pp. 32–3.]

There are nine municipal continuation schools for girls[6] in which one finds modern languages, book-keeping, commercial correspondence, caligraphy, stenography, and typewriting. [Sec. 8, pp. 33–4.] There

[1] *Cours commerciaux gratuits du soir de la Société pour la défense du commerce de Marseille.*
[2] *Institut populaire d'enseignement commercial.*
[3] Städtische Fortbildungsanstalten.
[4] Städtische Fortbildungsschulen für Jünglinge.
[5] Die Fortbildungsschule des Handwerker-Vereins, Sophienstrasse 15, and Gipsstrasse 16a.
[6] Städtischen Fortbildung für Mädchen.

There are further four girls' schools under unions or curatoriums, with commercial subjects. [Sec. 9, pp. 34–5.]

Thus, as one sees, there are no less than thirty-seven schools in Berlin alone for *elementary* commercial education, in all of which the fees are very low [*See* Chap. VI.] Some idea of the large attendance at these may be had by reference to page 30 of this report.[1]

Besides the day and evening schools, there are about 200 middle schools in Germany which are practically secondary schools of commerce and usually are of three years duration, sometimes with a preparatory year.[2] Entrance takes place at 14 years of age. Below these there are elementary schools, entrance into which may take place also at 14 years of age. The courses in these are of shorter duration and are of a more elementary character.

7. *Lower Commercial Education in Russia and Switzerland.*—The more elementary type of commercial school in *Russia* has a three-years' course, with a programme as follows :—

Subjects.	Years. I.	II.	III.	Subjects.	Years. I.	II.	III.
Religion	2	2	2	Correspondence	...	...	2
Russian	5	3	3	Commercial Geography, Russia ...	3	3	3
Commercial Arithmetic and Elementary Algebra	5	4	3	History of Russia	2	2	...
Geometry	2	2	...	Study of Local Merchandise ...	3	3	4
Book-keeping	..	4	6	Writing	2	2	1
Commerce, Com. and Indust. Laws...	2	2	3	German (optional)	6	6	6

The course is obviously liberal as well as vocational.

In *Switzerland* there is a great variety of organisation. The Report gives some idea of this for Berne, Geneva, Lausanne, and Winterthur. [Chap. LX, secs. 1–12, pp. 818–833.] Reference to commercial education in Switzerland was made in the report on Primary Education. Thus in the Canton of Geneva, in the evening classes, among other things, both boys and girls in a two-year course learn commercial arithmetic, modern languages, book-keeping, etc. [Int. Report, chap. V, sec. 3, pp. 33.]

The programme of a commercial section of an "*école secondaire et supérieure des jeunes filles à Genève*" is given hereafter in the Report. [Chap. LX, sec. 9, pp. 823–4.] The curriculum is excellent and the school may almost be classed as a secondary commercial school. Similarly in regard to the *Töchter-Handelsschule* of Berne. [Chap. LX, sec. 2–5, pp. 818–820.] The organisation of some of the Swiss systems is given in the Interim Report—[Int. Report, chap. V, sec. 4, p. 36, and sec. 9, pp. 48–9]—and more elaborately in the Report on Secondary Education—[Rep. Sec. Educ., chap. XXVII, secs. 1–5, pp. 315-318].[3]

Briefly it may be said that the commercial schools are entered at the age of about 14, there are day and evening schools with the more elementary courses lasting as long as about three years.

8. *Elementary Commercial Education in England.*—The holding of examinations cannot be seriously regarded as constituting education; nevertheless the syllabus of examinations for the "Junior Commercial Certificate" of the London Chamber of Commerce will disclose, in an imperfect way at least, what is expected of candidates. The examination consists of an obligatory and of a so-called optional part. The *obligatory* includes the following, viz., (1) English grammar and composition, arithmetic, a modern foreign language, commercial geography, commercial history, elements of political economy. The

[1] "*Die Allgemeinbildung in Kaufmännischen Fortbildungsschulen*" in the Zeitschrift für das Gesamte Kaufmännische Unterrichtswesen of February, 1904 discusses the character of the education thus provided.

[2] See the programme for a Dresden commercial school, page 786, by Mr. J. W. Turner.

[3] See alse sec. 27, p. 330.

The "optional" subjects, of which two of a group must be taken however, are the following, viz.:—

Mercantile group:—Commercial arithmetic, book-keeping, advanced drawing, freehand, model, designing, mechanical, geometrical or perspective, shorthand or stenotypy, typewriting.

Linguistic group:—French, German, Spanish, Portuguese, Russian, Italian, Dutch.

Mathematical group:—Algebra, Euclid or geometry, trigonometry.

Scientific group:—Chemistry; sound, light, and heat; electricity and magnetism; botany.

It may be mentioned that practical work is required. [Chap. LI, sec. 11, pp. 732–3.]

For further details, and for information regarding the senior examination, reference should be made to the report.

There are a number of commercial evening schools established by the County Council of the West Riding of Yorkshire, in which there are two-year courses in some centres and three-year courses in others. These meet three evenings a week for $2\frac{1}{2}$ hours each evening, and for 30–33 weeks per year.

A number of evening continuation schools have been established in various parts of England giving instruction in commercial arithmetic, book-keeping, commercial geography, commercial history, commercial correspondence, and the routine of the business office.

The *Commercial Arithmetic* is of three grades, viz.:—

(i) Abbreviated methods of computing, interest and discount, mental calculation, questions of average, commission, brokerage, surfaces and volumes, the metric units, French currency, etc.

(ii) Questions of stocks and shares; of profit and loss; bills receivable and payable with interest and discounts; the application of logarithms to calculations of compound interest, insurance, and annuities, etc.; weights and measures of Germany, India, the United States, and the more important countries of Europe.

(iii) *Either* freights, bills of lading, harbour and similar dues, rates of exchange in transactions with home or foreign bills, currency of China, Japan, and other European countries;—

Or debentures, preferred and ordinary stock, profits and dividends, liability, solvency, liquidation, banker's interest, computations of rates and taxes, repayment of loans, and compound interest in relation thereto.

Book-keeping is similarly divided into three grades, viz.:—

(i) Double entry with simple accounts, sales-book, cash-book, journal, and ledger. Invoice statements, writing cheques, simple sets of accounts.

(ii) Journal, purchase, and sales day-books; returns-book; cash, petty-cash, and bill books, ledger. Stock-taking, trial balance, balance-sheet, making analysis and summary of subsidiary books, assignments, royalties, meaning of terms such as f.o.b., bonded goods, underwriter, clearing a vessel, vendice, etc., etc. Consignment notes, bills, credit slips, entries for outgoing and incoming consignments.

(iii) Classification of capital, money, property, stocks, shares, revenue accounts, use of private ledger, sinking funds, investment accounts, public, railway, municipal accounts, consignment transactions, and with dishonoured bills, bad debts; partnerships, division of profits and losses, allowance for depreciation.

Other subjects are treated in much the same manner.

The above is a sufficient indication of the treatment of the subject in the English continuation schools.

Commercial education, properly so-called, is being introduced also into the high schools of Scotland. 9.

9. *General Remarks.*—The analysis of the types of elementary commercial instruction, given in section 2 hereinbefore, sufficiently indicates the varied character of existing forms of instruction. There is no doubt that the organised courses are better than independent courses. The latter form of commercial instruction adopted in many of the business colleges is not productive of results comparable with those attained by the organised method. It may also be said that the systematic teaching of a properly-equipped commercial school, with resources for teaching science as applied to commerce, and with a commercial museum, is uniquely the best.

Continental Europe, and America have fully recognised the value of commercial courses. England is somewhat tardily following, and very inadequately in relation to the immense issues she has at stake. Throughout the world, one might say, and certainly including Japan, it has come to be recognised that commercial education must be established, if national efficiency is not to be sacrificed.

In Sydney there are business colleges which give instruction in typewriting, supply typewriting machines, and give commercial and other courses of a more or less varied character. The Chamber of Commerce holds examinations, and recently endeavoured to induce the University to take over the whole duty, thereby accentuating the crying evil of the examination system, one of the most conspicuous defects of English education. But we have no courses of the well-ordered character of those in Europe. Good teachers, well-organised curricula, and properly-equipped schools, are the rational means of making elementary as well as any other grade of commercial education what it ought to be.

XVIII.

CONCLUSIONS CONCERNING COMMERCIAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—"Is commercial education of any moment"? is a question to which a world-wide answer has been given in the affirmative. The provision made for such education in the United Kingdom is *lavish* as compared with that made in this State; and in Europe it is lavish as compared with that made in the United Kingdom; and there can be no doubt, therefore, that the Chamber of Commerce of Sydney has rightly apprehended the urgent need of attention to this want of the community.

Our average annual total trade lately has been about £54,000,000. Would $\frac{1}{10}$ per cent. be a very heavy surcharge to be applied to the educational equipment of those engaged in trading? This would represent no less than £54,000 per annum. Even $\frac{1}{50}$ per cent. means no less than £10,800, a sum which could do much for commercial education, for it is seriously neglected at present.

Commercial men complain that the defective preparation of youths for employment in their business houses impairs business; they regard the matter as one of urgency, and propose what?—not to establish good schools—but to hold examinations! This is only an evidence of how little we believe in education, and how imperfectly education is popularly understood.

2. *The Lesson of History as to Commercial Education.—France learnt through her national reverses in* 1870 *and* 1871 *to recognise the reality of her limitations,* among which the inadequacy of her scheme of commercial as well as industrial education may be mentioned as having been specially indicated. The "Committee for the encouragement of commercial studies"[1] was actually founded by M. Bamberger as a direct corrective for such disaster. He believed that the reinforcement of the teaching power of the commercial schools was essential, and gave bursaries to enable masters of secondary instruction to acquire experience in foreign countries, as well as in France, in practical business.

France has other philanthropic societies of the same character.[2] Her Chambers of Commerce, humbled by disaster, were able to recognise that the *defeat was due to German educational superiority.* And, in 1871, at Marseilles, the great Higher School of Commerce, was founded to repair the disaster which war had brought about. It was incisively stated that it was little use to reorganise the army and re-establish its fortresses, unless all that was incomplete and defective in French habits, manners, and education were altered. Intelligent Frenchmen said that they had been vanquished by education before they were humiliated by arms. So remarkable are the words of M. Courtot in his report and proposal to found the School, that they may well be given here:—

> "Avant de nous vaincre par les armes, l'étranger nous avait déjà vaincus par l'instruction, dont le développment était favorisé chez lui par tous les moyens . . . . . . Ce ne serait donc par assez pour la France de réorganiser son armée et de fortifier ses places de guerre si, en même temps, nous ne travaillons pas à la régéneration de notre pays et si nous ne modifions pas, dans nos habitudes, dans nos mœurs et dans notre instruction, ce qu'il y a de défectueux et d'incomplet."

History

[1] Comité d'encouragement des études commerciales en France.

[2] *E.g.* "L'Institut populaire d'enseignement commercial," with a staff of about twenty-five professors and teachers, and about 500 pupils.

History had, in a way, repeated itself and, with the irony of fate, Germany taught the French Republic the same lesson that, two-thirds of a century before, Napoleon I had taught Prussia. And the remedy proposed was again the same, to restore national power and prestige by better education.

No one who is sufficiently concerned about our educational delinquencies to inform himself as to our real position, will fail to see that in commercial, as in other forms of education, we are wholly in the rear. So remarkably insular and narrow are some of our traditions and beliefs, that prominent commercial men have expressed the opinion that we need take no account of modern languages—the foreigner can learn ours.[1]

There are two ways of learning the truth, viz., through the humiliation of defeat, which discloses what the unrecognised truth really is, when it is too late to amend; or by intelligent study of our place in human affairs, by which the remedy can be applied so as to anticipate and, perhaps, to wholly avoid disaster. And it is well, therefore, to ask ourselves, if our educational deficiencies do not demand urgent attention?

3. *Schools versus Examinations.*—The chapters relating to the subject disclose at least this, that such commercial education as exists in our State is not to be compared with that in Europe or America, and the only serious attempt made to remedy the existing condition of things has been made by "private adventure" business schools. The proposal made to hold examinations is quite unworthy of any educational authority.

Examinations tend to promote cramming, especially when there is no other gauge of what they are likely to be than the papers of past examinations, and the briefest possible outline of the course of the examination. One would almost imagine that our system was designed for the special benefit of "coaches." In practice it works out badly. Students read for examinations, not for solid mastery of subjects; and this is well known, however much it may be hidden from ulterior motives.

Coaching is, after all, teaching of a kind, but it is not to be compared with the systematic teaching of schools, for the coach has always to work under limitations. The only thorough method is to build properly designed schools; to suitably and sufficiently equip them with aids to teaching; to furnish them with appropriate laboratories; and, above all, to see that the *personnel* of the teaching staff contains men of some ardour in their vocation, men well-educated and trained for their work.

How far the commercial education of Europe or America responds to these ideal conditions may not be completely evident from the report, but there is ample to shew that we have everything to do. We have not even made a beginning.

4. *The Promotion of Commercial Education.*—The interest which the Chamber of Commerce has taken in commercial education, and the very direct benefit which commercial men will receive from the establishment of commercial schools of a thorough type, will no doubt reproduce a state of things which is characteristic in Europe and America. There, commercial education is endowed or subsidised; bursaries are numerous; and societies are formed for the promotion of thorough instruction; and so on. All this is done by Chambers of Commerce and analogous institutions. Public spirit is ever ready thus to express itself in countries that possess it in any measure.

5. *Conclusions and Recommendations.*—To reach satisfactory results, the primary school must of course do its work properly. It has to lay the necessary foundation, on which the commercial superstructure is to be built. And when the primary shall have been reorganised on sounder lines we shall be in a better way in this as in other respects.

Secondly,

---

[1] This, despite the fact that the commerce of the United States in South America has met with reverses through an indifferent knowledge of Spanish. To which the reply may be anticipated that the conditions are different here!

Secondly, the properly educated and trained teacher will doubtless be able to commercially orientate the lessons of the primary school, so as to make them commercially helpful. While none of the subjects should be made purely technical, they can easily be practically orientated by such a teacher so as not to lose cultural value.

Thirdly, our system must provide for those who can attend for instruction only in the evenings, as well as for those who can attend in the day-time. Hence two grades of continuation schools are necessary, viz., the more elementary evening commercial school, and the higher grade day school with a really well-organised commercial course.

And beyond this again, and to ensure better training of commercial teachers, the University ought to provide the highest form of commercial education. It is well worth while, as a review of even the existing magnitude of our annual trade abundantly demonstrates, to say nothing of what it might develope into as the level of commercial education is raised and general progress advances.

In submitting the following positive recommendations, the Commissioner would point out that the total magnitude of the outlay is incomparably less than that which progressive countries are prepared to make. We cannot have good education without paying for it; but the evidence of the industrial progress of, say, Germany and America, assuredly leads to the conclusion that education is to a people what proper preparation and treatment of the soil is to agriculture. It pays. That niggardliness in education is economically unsound has been demonstrated by recent history. The following are the conclusions and recommendations of the Commissioner:—

(1) Subject to conditions hereinafter mentioned, commercial education of the highest grade should be established in the University. The curriculum in commerce should be three years. The preparation for entrance to this should be a secondary school education with instruction in science. Latin or Greek, if asked for, should be quite optional. At least one modern language should be *compulsory* for entrance.

Special courses in physics and chemistry, and in botany and zoology, would be necessary, the usual courses being unsuitable. These special courses should be commercially orientated.

(2) Day commercial schools of secondary grade should be established in connection, initially, with the technical educational system. The necessary instruction in physics, chemistry, botany, zoology, should be specially orientated with regard to commerce. The technological museums, in some cases, already contain the nuclei of museums for commercial instruction in the technology of merchandise. The courses should be an elementary course of two years, followed by an intermediate of one year, and, later, an advanced course of one year—four years in all.

The entrance condition should be a primary school education up to the stage normally reached, say at 14 years of age.

(3) Evening commercial schools should be established, also, in connection with the scheme of technical education. The curriculum in these schools should be so arranged as to make good the lacunæ in practical experience under local conditions, and to supply theoretical as well as practical commercial instruction, supplementing that which can be acquired in practice.

The courses should be, elementary two years, advanced one year extra, and the condition of entrance a primary education up to the normal leaving stage, say 14 years.

Some of the aids to instruction already exist in the technical colleges; they would have to be supplemented.

(4) Independent courses in commercial subjects should be widely established throughout the State, wherever students offer in sufficiently large numbers.

(5) Nature-study, elementary science, mathematics, geography, and history should be so treated in the schools of Sydney as to suggest relations with commerce. Arithmetic, elementary algebra, geometry, and mensuration, can be educatively treated, and at the same time be so handled as to constitute a significant preparation for commercial education: this should be done, and will be easy when the teaching staff is properly educated and trained.

(6) Special courses of instruction in science, orientated with regard to commerce, should be a feature of the instruction in as many of the technical colleges as possible.

In connection with these recommendations the following observations are necessary:—

(7) If the University would prefer to retain its present condition of compulsory Latin for all matriculates, it would be preferable to establish, as soon as possible, a high school of commerce of university grade. This could be in close touch with the University; that is to say, the students could attend some of the University courses, provided they were suitable.

(8) If the higher school commerce be within the University, *special* courses in physics, chemistry, geology, zoology, botany, etc., having more immediate relation to commerce, would require to be instituted. If courses in general technology be developed, these would be of value.

(9) The *Professor of Commerce*, in addition to possessing the proper general attainments, should be thoroughly acquainted, by direct study therein, with the methods of at least one of the leading high schools of Europe, viz., such a school as that of Antwerp, Cologne, Leipzig, Neuchâtel, Vienna, etc. English experience alone should be regarded as inadequate.

(10) The remarks of sections 10–19 of Division XIII of this summary apply *mutatis mutandis*, to the preceding recommendations.

(11) Throughout, the commercial courses should not be merely vocational, but should be as liberally organised as the exigencies of the particular school will allow.

XIX.

XIX.

GENERALITIES CONCERNING HIGHER TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—Setting aside the consideration of medicine, surgery, and dentistry, higher technical and professional education is represented in this State by courses in civil engineering, mechanical and electrical engineering, mining and metallurgical engineering. For each of these there is a definite curriculum, and no options are permitted. One who wishes to be a metallurgical specialist, therefore, must perforce be also a mining engineer, and similarly throughout.

There is some excuse for this, for, owing to the great imperfections of our whole primary and secondary educational system, students enter the University not sufficiently well-prepared to attempt courses of the type to be found in the technical and other Universities of Europe. Hence English and also many American Universities, and our own University, are found doing what would be regarded in Europe as secondary school work. The University curriculum has perforce to include work in science subjects, which can be regarded only as elementary. Hence, to secure some degree of thoroughness, the student is allowed no options; he is really not trusted to form opinions as to what he needs for his career. If he wishes to graduate he must do it on certain defined lines—lines which are not merely commended to him, as is often the case in Europe, but which are thrust upon him.

Limitations in the numerical strength and scheme of qualification of members of the staff also impose a difficulty. That a people numbering about one and a half millions should have its higher educational requirements in science met by only one professor of chemistry, only one of physics, only one of engineering, only one for botany and zoology together, one for geology, and so on, distinctly marks our failure to respond to that intense belief on the value of scientific education which is characteristic of Europe, and which is illustrated by the princely gifts of American plutocracy for the development of higher education in the United States. The paucity of equipment as regards teaching personnel is the more significant when the poverty of our secondary educational system is taken into account. Reference has been made to the matriculation conditions of the University of Sydney, which impose upon students, of every faculty, the passing in *Latin.* It has already been mentioned that this attitude has been abandoned practically throughout the world. [*See also* Rept. Sec. Educ., Chap. III, sec. 10, pp. 25, 26.] As means of accentuating class distinctions, Latin and Greek operate tolerably effectively; it has indeed been said that the unique position assigned to these languages in England has created " a sort of an educational aristocracy with the badge of Greek and Latin "[1]; nevertheless, it will be obvious to anyone who will carefully weigh all the evidence, that the insistence on Latin is, as has been said, " a millstone about the neck of British industry,"[2] a millstone too which England's great competitors have cast off. It

[1] Commercial Education, Herrick, p. 135.
[2] Magazine of Commerce, December, 1902.

It is well recognised that the ancient languages are not necessary for technics generally; that the modern languages are far more useful, and are liberal and cultural in as high a sense as the dead languages. Modern English universities have all abandoned Latin as a compulsory subject, except for certain subjects, as law, etc.

The prevailing state of things here makes it evident that we shall do well to promote those types of education, which, *while retaining the really liberal and cultural elements,* are of direct practical value.[1] A narrow conception of utility would undoubtedly be a hindrance to good education, but good education is by no means inconsistent with utility.

2. *References to Higher Technical Education.*—It is not easy to define higher technical education, because the most advanced form in one country may be only equal or even inferior to secondary technical education in another. A study of the chapters quoted hereunder will, however, lead to a definite understanding of the matter.

References to Higher Technical Education.

Chapters.	Sections.	Pages.	Refers to.
VIII	11, 12	72–4	Higher School for Engineering Construction, Hamburg.
"	15–17	75–77	Higher Schools for Shipbuilding and Electro-technology, Hamburg.
XI	14	118–121	Higher Secondary School for (1) Builders and Architects, (2) Mechanical Engineers, (3) Electro-technologists, (4) Chemists, (5) Surveyors and Agricultural Engineers, Winterthur, Switzerland.
"	15, 17	122–127	Details of courses of some of the preceding subjects, viz., (3), (5).
XIII	12	154	Courses in Architecture, Civil and Mechanical Engineering, Chemical Technology, Land-surveying; Polytechnical Institute, Helsingfors, Finland.
XV	4, 6	162–4	The Technical Institutes of Italy.
"	7	165	Nautical, Naval Construction, and Marine Engineering sections of the Italian Technical Institutes.
"	8	166	Turin Higher Technical School (Germano-Sommeiller).
"	9	166–7	Royal Industrial School of Naples (all these are really secondary schools).
"	14	169–170	Technical Education in Japan.
"	16–18	170–1	" " Portugal.
XVII	2, 3, 4	185–6	Organisation of Technical Education in Russia.
XXIX	1–9	294–7	General view of Higher Technological and Professional Education.
XXX	1–6	298–301	Various forms of French Technological Education.
"	7–29	301–8	School of Mines, St. Etienne, curricula and details of the courses.
"	30	308	Brief reference to other French Technical Schools.
XXXI	1–15	309–317	Courses in Architecture, Civil Engineering, Mechanical Engineering, Naval Architecture and Marine Engineering, Chemistry and Metallurgy, General Science, Charlottenburg, Berlin.
"	16	317	Student journeys for higher Technological Education.
XXXII	1–18	318–335	Technical High Schools of Germany, and details of the Munich programmes in Mathematical and Natural Science, Building and Engineering, Agricultural Science, Drawing and Modelling, General Subjects, Civil Engineering, Architecture, Mechanical Engineering, Electrical Engineering, Chemistry and Agriculture.
"	19, 20	336–7	The Doctorate Degree and Regulations, Munich Technical High School.
XXXIII	1–11	339–348	The Federal Polytechnic at Zurich, and its courses in Architecture, Engineering, Mechanical Technology, Chemical Technology, Teaching Mathematical and Science Subjects, General Philosophy and State Economics, Military Science, etc.
"	12	348–354	Organisation as to Teaching Staff, and their Subjects, Federal Polytechnic of Switzerland.
"	13, 14	355	Equipments, Institutes, Library, etc., of above school.
XXXIV	1–3	356–7	Organisation of Higher Technical Education in Austria.
"	4	357–8	Courses in Architecture, Civil Engineering, Machine Construction, Mechanical Engineering, Chemical Technology, Land Surveying, in Helsingfors, Finland.
"	5	358	Courses in Civil Engineering, Architecture, Naval Architecture, Mechanical Engineering, Mining Engineering, in Holland.
"	6–12	358–9	Engineering, Architecture, Electrotechnical Science, Electro-chemistry, Tinctorial Chemistry for Paper Manufacturers, Industrial Engineers, in Italy.
"	13–14	360	Courses for Teachers of Technical Subjects, Italy.
"	16–21	361–4	The Great Technical High Schools of Russia, and details of the various courses.
"	22–33	364–372	Courses for Mechanical Engineers and Technologists, Shipbuilders, Electro-Technology, Chemical Technology, Mining and Mining Mechanics, Mining and Metallurgy, Practical Mining, Architecture, Hydraulic Construction, Sweden.
XXXV	1–2	373–5	Extensive provision for Higher Technical Education in the United States.
"	3–11	375–380	Courses, Civil, Mechanical, Electrical, and Chemical Engineering, and Architecture, etc., Washington University, St. Louis.

[1] Rept. Sec. Educ., Chap. III, secs, 1–9, pp. 13–30.

REFERENCES TO HIGHER TECHNICAL EDUCATION—*continued.*

Chapters.	Sections.	Pages.	Refers to.
XXXV	12–19	380–6	Courses in Brooklyn Polytechnic in Arts, Chemistry, Civil Engineering, Electrical Engineering, Mechanical Engineering.
"	20–25	386–392	Courses in Mechanical and in Civil Engineering, Chemistry, Electrical Engineering, General Science, Worcester Polytechnic.
"	26	392–3	Graduate Courses, Worcester Polytechnic.
"	27–33	393–7	Courses in Mechanical, in Civil, and in Electrical Engineering, Architecture, Chemistry, Rose Polytechnic.
"	34–7	397–9	The Rensselaer Polytechnic and its courses in Civil Engineering and Natural Science, etc.
XXXVI	1–26	400–421	Courses in Civil, in Mechanical Engineering, Mining Engineering with Metallurgy, Architecture, Chemistry, Electrical Engineering, Biology, Physics, General Studies, Chemical and in Sanitary Engineering, Geology, Naval Architecture, Massachusetts Institute of Technology, Boston.
"	27–30	421–2	Conditions for Graduation, same Institute, and Advance Courses generally therein.
"	31–41	422–6	The Laboratories and their Equipments.
XXXVII	1–8	427–432	The Stevens' Institute of Technology, Hoboken, New York; its Organisation, Courses, and Equipment.
XXXVIII	1–55	433–462	Technical Education in the Universities of the United States, viz., Harvard, Berkeley (California), Cornell, Yale, Pennsylvania.
XXXIX	7–55	467–495	Technical Courses, Birmingham University, British School of Malting and Brewing, Liverpool University Courses, Technical Courses in Victoria University; in Yorkshire College, Leeds; in Durham College of Science; in King's College, London; in the Universities of Edinburgh and Glasgow; in the Heriot-Watt College of Edinburgh; in the Royal University of Ireland; in the University-Colleges of Aberystwyth, Bangor, and Cardiff, Wales; in the Manchester School of Technology.
"	56–59	495–6	The Higher Courses of the City and Guilds Technical Colleges.
"	64–73	501–5	Higher Courses, East London Technical College, and Chelsea Polytechnic.
"	95–96	512–4	Leeds Technical School and its Higher Technical Courses.

Many of the above belong to secondary rather than to higher technical education, but it is difficult to make a hard and fast line of demarcation between the two. They will be discussed in their proper connection.

3. *Definitely organised Higher Technical Courses of Instruction.*—In order to make clear the range and variety of higher technical education, the following list gives, in alphabetical order, most of the definitely organised courses of instruction to be found in various countries. To make it tolerably complete, agriculture, forestry, etc., have been included. The list is, however, by no means exhaustive.

List of Technical Organised Courses.

Agriculture; Agriculture and Forestry; Agriculture and Horticulture; Agricultural Chemistry; Agricultural Engineering; Agricultural Technology; Agronomy; Agronomical Engineering; Architecture (ordinary and Naval); Architectural Technology; Brewing and Malting, etc.; Building and Architecture; Chemistry (general, agricultural, electro-, technical, tinctorial, technological, etc.; General Chemical Technology; Commerce; Commercial Teaching; Engineering (general, agricultural, chemical, civil, electrical, industrial, marine, mechanical, metallurgical, mining, mining and metallurgical, municipal and sanitary, railway); Forestry; Geodesy and Surveying; Hydraulic Construction; Hydraulic Engineering; Industrial Engineering; Malting and Brewing; Marine Construction; Metallurgy; Metallurgical Technology; Military Science; Mining; Mining Mechanics; Mining and Metallurgy; Municipal and Sanitary Engineering; Naval Architecture; Naval Construction; Paper Manufacture; Practical Mining; Railway Engineering; Ship-building; Surveying; Surveying and Agriculture; Surveying and Geodesy; Surveying and Estate Management; Technology (general, agricultural, chemical, electro-, mechanical; Veterinary Medicine and Surgery; Veterinary Science.

The detailed subjects connected with these courses are very numerous indeed. The best illustrative examples in the report are the courses of the *Technische Hochschule* of Charlottenburg, near Berlin, perhaps the most magnificent technical University in the world, and the *Eidgenössische Polytechnische Schule* of Zurich, which

which also is a magnificent technical University. By way of illustrating the point just made, the courses in various departments of the Charlottenburg Technical High School may be mentioned. In the department of *Architecture* there are ninety-eight courses in the four years of study required [Chap. XXXI, sec. 8, p. 311]; in *Civil Engineering* there are sixty-five courses in the four years [sec. 9, pp. 311-2]; in *Mechanical Engineering* there are no less than 138 courses, this being explained however, by the fact that, in the last (fourth) year, there are the following divisions, viz.:—(1) *General Mechanical Engineering*; (2) *Railway Engine Construction, etc.*; (3) *Electro-technology* [sec. 10, pp. 312-3]. It is worthy of remark that practical questions of the day are treated [course 126]; the history of socialism [course 127]; general political economy [course 128]; the elements of financial science [course 129]; industrial law [course 130]; commercial law [course 131]; patent, trade-mark, and similar laws [course 132]; any many analogous subjects [*see* p. 313].

The courses in *Naval Architecture and Marine Engineering* number 41 [Chap. XXXI, sec. 11, p. 313]; those in *Technical Chemistry*, 58 [sec. 12, pp. 313–4]; in *Metallurgical Engineering*, 56 [sec. 13, p. 314].

The practical exercises are excellently arranged, and in the *physical laboratory* they number 112 [sec. 14, pp. 314–5]; in the *electro-technical laboratory* they number 88 [sec. 15, pp. 315–7].

The courses in the *Technische Hochschule* of Munich are also well worthy of study [*see* Chap. XXXII, secs. 2–18, pp. 318–335]; so also are those of the *Eidgenössische Polytechnische Schule* at Zurich [*see* Chap. XXXIII, secs. 4–11, pp. 341–8].

For an example of the thoroughness with which individual subjects are treated, reference may be made to the synopses for the *Ecole des Mines de Saint Etienne*. The course is three years. There are 21 lectures in mathematical analysis [Chap. XXX, sec. 8, p. 302]; 25 in rational mechanics [sec. 9, p. 302]; 20 in applied mechanics [sec. 10]; 23 in physics [sec. 11]; 30 in mineral analysis [sec. 12, p. 303]; 24 in mineralogy [sec. 13]; 24 in perspective and stereometry [sec. 14]; 12 lectures in surveying [sec. 15, pp. 303–4]; 45 in the exploitation of mines [sec. 16, pp. 304–5]; 35 in metallurgy I [sec. 17]; 40 lectures in applied mechanics [sec. 18]; 20 in construction [sec. 19]; 15 lectures in geology I [sec. 21, p. 306]; 24 lectures in metallurgy II [sec. 22]; 25 in geology II [sec. 23]; 30 lectures in electricity [sec. 24, pp. 306–7]; 15 on railways [sec. 25]; 16 on mining legislation and industrial economy [sec. 26]; 6 on accountancy [sec. 27, p. 308]; and 6 on vegetable palæontology [sec. 28].

4. *Thoroughness of Preparation for Higher Technical Education in Continental Europe.*—The generalities of the question of higher technological and professional education, discussed in the Report [Chap. XXIX, secs. 1–9, pp. 294–7], shew that its success is dependent upon (*a*) sound initial education; (*b*) differentiation between pure and applied science—therefore, between technical and University education; (*c*) the replacement of purely empirical treatment of professional matters by rational treatment.

The technologist must necessarily be appreciative of pure science, which is essentially *non-utilitarian;* hence the scientific basis of his education should be laid in the elementary and secondary school career. So well has this been recognised in some countries that if a student has had mainly a classical education he is specially required to take such courses in science, *i.e.*, physics, chemistry, etc., as will make good the deficiencies of his preliminary education.[1]

The "Conditions of Entrance" into the Technical High School of Charlottenburg may be taken as illustrative [Chap. XXXI, sec. 3, p. 309]. They are that the student must possess the Maturity Certificate (*Reifezeugnis*) of a Gymnasium, or a Realgymnasium or Realschule of the first rank, or of an Oberrealschule, or of a Gewerbeschule with a nine years' course, in which the study of two foreign languages is included; or produce satisfactory evidence, subject to Ministerial approval, of sufficient preliminary education.

The demand that the student shall have received a sound preliminary education, which is characteristic of Europe, is the secret of the great excellence of the higher education therein, both in the University and in the technical high school.

In

[1] It is becoming more clearly recognised that education which takes no account of science is half education only; that it is a misnomer to call persons without scientific instruction *liberally* educated; that to really understand humanity and things human it is essential to include both literature and science.

In the secondary report the knowledge of physics and chemistry, demanded for entrance into the *Ecole Polytechnique*, was given [Rpt., Sec. Educ., Chap. XVII, secs. 13y, 14, pp. 206 and 209.] In this Report the knowledge demanded for admission into the *Institut National Agronomique* of France may be found. [Chap. XLIV, sec. 2, pp. 580–5].

5. *Characteristic Differences in Preliminary Qualification for Technical and Professional Courses.*—The express object of the Commissioner in translating at length the entrance conditions above referred to was to disclose, and to bring into the clearest possible relief, the extraordinary difference in the state of preparation for advanced courses in continental Europe, and in that which is usual in the United Kingdom and her colonies [*loc. cit.*, p. 585].

Owing to the strongly classical bias of the majority of the English secondary schools, and the absence of anything like a definite organisation of educational effort, matriculates of English Universities, even those which offer higher technical courses, frequently enter upon such courses quite innocent of any scientific knowledge. Many educationists in England see the ridiculousness of this, and scientific men deplore it. But classical education is so popular, and so effective in the accentuation of a meretricious distinction, that attacks on that state of things have, on the whole, been ineffective, at least so far.

In the more democratic parts of England, scientific education is distinctly better;[1] but nowhere is it comparable to that of Europe, because of the general inferiority both of the educational system, and of the material equipment for teaching science in the secondary schools.

There is only one remedy for this state of things—that is, the introduction of science teaching into the elementary, and primary, the preparatory, and secondary schools; their proper equipment for such teaching; and also the definite organisation of secondary education. This will be obvious when the evils arising from the English *penchant* for examinations is inquired into.

In America, speaking generally, the preparation for higher technical education is better, partly because science is not "*tabu*," and secondary schools are often well equipped for teaching, and partly because the courses themselves often offer the necessary preparatory studies. In other words, one finds in the Universities and technological institutes of the United States, instruction that belongs to the European scheme of secondary education. For this reason the American organisation is not the peer, in many respects, of the German, for example.

Owing to the introduction of liberal forms of advanced manual training in the American secondary, grammar, collegiate, or high schools, and also often of fairly well advanced scientific instruction, the advantage may some day lie with the United States instead of with Germany.[2] The liberal options, also, which exist in the American colleges, are tending towards their thoroughness of secondary, which has been attained by the creation of the three types of higher secondary school in Germany, viz , the Gymnasium, the Real-Gymnasium, and the Oberrealschule.

If American secondary education were as thoroughly organised, say on three definite lines—three is quite enough—as in Germany, and had liberal and well organised courses of manual training, and also sound scientific instruction, it would be ideal; but it cannot reach that without admitting that secondary education is not a mere upper extension of primary education—a point which has already been discussed.

The conspicuous defect, then, of most of the continental systems of preparatory education for the higher courses is the absence of educative manual training; while that of the American preparation is the absence of a sufficiently well-defined and correlated scheme of secondary education, which distinctly recognises that such education is not merely a continuation of primary.

In the judgment of the Commissioner here writing, that country whose educational machinery is *selective*, in the sense of early determining which pupils are to step aside and walk on the severer path of secondary education, instead of continuing to the higher branch of primary, is the one which must inevitably take first place ultimately in human competitions, other things of course being equal. This method alone gives to a general population enough intelligence to be led by an aristocracy

[1] In general, it may be said, that in certain circles the natural sciences are held in good-natured contempt; it is "bad form" to be interested in "stinks"—*i.e.*, chemistry, physics, etc.

[2] Hardly in the near future, however.

aristocracy of intellect wise enough to lead. All cases of late development of pupils will be necessarily exceptional, and though they involve loss of time, by late change from the primary to the secondary path, yet the comparative infrequency of such cases shew that they do not stultify the scheme.

The parting of the ways between primary and secondary educational paths allows to each branch that type of educational development which will be most valuable, while it secures what is essential, viz., the only form of aristocracy of intellect consistent with equal opportunity for all, and consistent with the evolution of the highest intellectual and educational achievement.

6. *The Evils of the Examination System as regards Higher Technical Education.*—All examinations, and especially written ones, tend to tempt students to load the memory for the examination period, and, as is well known, the passing of examinations is not so well assured by steady and thorough study, as by making a feverish temporary demand on a kind of short memory, which may be cultivated for examination purposes (the type of memory involved in "cramming").

Our besetting educational vice is the admission of educational conditions which lend themselves to the maintenance of a type of examination such as leads to cramming of the worst kind. *This is excused on the ground of a supposed necessity.* But the necessity does not really exist; and since English education, and that in this State, are most dangerously hindered by the conditions referred to, it is necessary to point out the remedy.

First of all, it may be remarked that the educational folly of over-burdening is being yearly more and more keenly appreciated, and in the recent "*Congress of the Royal Institute of Public Health,*" in England, held this year (20th July, 1905), the subject of neural injury through over-burdening was discussed very fully. Dr. T. B. Hyslop, resident physician of Bethlehem Hospital, in a paper on "*Brain fag in children,*" shewed that the consequences of the prevailing method were leading to "brain suicide of the race." The following extracts from his address are to the point:—

> "As the educational ladder . . . . becomes more difficult to scale, so the residuum of failures becomes more and more noticeable in our asylums. . . . . We are months learned, years demented. . . . . Learning by rote is . . . . deleterious. It is one of the worst causes of brain-fag, and is largely due to competition, as determined by our vain-glorious system of merely accumulating knowledge. . . . . Premature degeneration serves to explain many of the early victories as students but later failures as men."

A delegate of the "Headmasters' Conference," the Rev. R. S. Laffan, declared that the enormous pressure of examinations "is killing proper education as well as health."[1]

Anyone who has had experience of the examination system of this State knows perfectly well that the scheme of passing examinations is educationally immoral. A student, perhaps especially one who does not naturally work rapidly, dare not aim at thoroughness; that would endanger his passing. It is practically better to *cram* for examinations, and to read for knowledge and sound intellectual development after passing them.

The creation of a system of examinations, held by the university or other authorities, in the attempt to appraise the standard of attainment reached by school pupils or students, as, for example, to decide whether they may be matriculated, is a direct consequence of the absence of a definite educational organisation, and of definite curricula, the subjects of which are taught by teachers of assured qualifications—that is, assured by a sound scheme of professional training to teach. And yet such persons are the *only* ones who can examine justly, and independently of a scheme which directly promotes cramming.

This educationally vicious method of continually proposing to hold examinations, instead of proposing to create well-equipped and staffed schools for such special teaching as is required,[2] has a profoundly detrimental influence on higher technical and professional education; it operates against thoroughness. This will more fully appear from other considerations which follow.

7.

---

[1] As a practical outcome of the discussion, it was moved by Professor Simpson that the present hours of sleep for Public School boys were too short, etc. . . . and that the opinion should be communicated to headmasters generally. [*See* London *Daily Telegraph*, 21st July, 1905, p. 10.]

[2] The recent proposal by the Chamber of Commerce that the University should hold examinations in order to promote commercial education is a case in point.

7. *Advantages made possible through adequate preliminary education.*—Where entrance into higher technical courses is made to depend upon satisfactorily passing through a suitable type of well-equipped and efficiently staffed secondary or special school, the curriculum of which also is properly organised and of a sufficiently advanced character, much greater freedom of choice can be conferred upon the student as regards his subsequent studies. In the professional or technical courses of the University, the reason why students are allowed no options is really that the courses have a double function; they are both preparatory and technical at the same time, and therefore are neither, thoroughly. If the preparatory function were relegated to the secondary school, and if students were treated as rational and responsible beings who could be left largely to their own choice of studies, the result would be vastly better. The estimation of practically everything by the results of written examinations is no doubt again responsible for the want of freedom in the selection of studies.

The difference referred to is the characteristic difference between English and German higher education. The "*Akademische Freiheit*" (academic freedom) of both German University and Technical High School has delighted everyone who has taken the trouble to understand it.

In this State, as in the United Kingdom, it does not exist. For example, a student may desire to be a metallurgist; it is demanded that he shall be also a Mining Engineer, because the graduate course includes both. He may wish to become an expert in some branch of Electro-technology; he must become a Mechanical and Electrical Engineer, or perhaps take Chemistry and Electricity in a science course. He may feel that his text-books are of far greater assistance to him than attendance on the lectures of a particular professor or lecturer; he must nevertheless attend, or he cannot graduate. He may be unable to satisfactorily follow the ordinary lectures; there are no recognised assistants or lecturers from whom he can get help, like the "*Dozenten*" of a German University.

In the American Universities, technological institutes, polytechnics, etc., the courses are generally of four years duration, *i.e.*, I Freshman, II Sophomore, III Junior, and IV Senior. The earlier part of the work, especially that in the freshman year, is often what in other countries is regarded as higher secondary-school work. But there are commonly a considerable number of "options" or "electives" allowed, so that the sphere of choice or self-determination is much wider with them than with us. The moral effect of this is of course good; it makes for thoroughness in the selected field of special study.

8. *Effects of being in touch with the highest planes of educational effort.*—There is, however, a still more important effect, consequent upon the system of thorough preparation, viz., one which is directly attributable to the raising of the whole plane of academic effort. To this reference may now appropriately be made.

In the system of this State, the student is rarely sufficiently advanced to undertake original investigations or researches, and, even if he were, his time is fully occupied with the routine work of the course which he is following. Hence, unless he can remain for post-graduate work, he will never come directly under the highest educational influences or experiences, viz., those which appertain to the effort to add to human knowledge.

Original investigations and researches, far better than anything else, reveal to students how insignificant their attainments are. Those who make no effort of this character—that is to say, those who do not undertake original work of some kind—are by no means free from imaginations that their achievements entitle them to be considered as well-educated. They are apt to fancy that the text-books they have read are pinnacles of knowledge, or perhaps even a summary of its highest elements in the several branches to which they refer. Students under our system are apt to attach weight to *erudition* rather than to *faculty*; they felicitate themselves upon their fund of information rather than upon the power of using it. They never get that necessary corrective, which comes from the overwhelming sense of colossal ignorance, the colossal ignorance even of the graduate. They know nothing of the exhilaration arising from independent effort; of fellowship, in original and creative effort and work, with those to whom the world owes its stores of accumulated systematised knowledge. They have never felt the consciousness of power which comes from ability to share in the highest planes of educational and scientific achievement, where information is but a means to an end.

The

The wealth of scientific discovery in continental Europe is very largely due to the spirit which has been awakened and developed by the original effort made possible through proper preparation and through the then permissible academic freedom—the freedom which can be granted to those whose preliminary education has been liberal and sufficiently extended; the freedom which allows a student to extend himself educationally for the sake of larger horizon and greater general command; or, on the other hand, to concentrate his effort within more limited field so as to ensure perfect grasp of detail.

Under the English system and our own, even post-graduate work will not bring so excellent a result, because of the deficiencies which have been pointed out in the organisation of secondary education. The student has neither the same initial liberal culture, nor the same thoroughly efficient preparation wherever educational organisation is defective.

9. *The teaching staff necessary for Higher Technical Education.*—There is a characteristic difference between the type of necessary qualifications for a scientific teacher in a University, and the teacher in a technical or professional school, which may now be referred to. The genius of the former should be in the direction of power of discovery; of the latter, in that of applying knowledge already discovered. Not that the two are inconsistent, but technical processes depend upon ability to command the resources of science which have been won by the non-utilitarian efforts of scientific investigators. The principles of the matter are discussed in the Report (*See* Chap. XXIX, sec. 2–7, p. 294–7) under the following headings, viz.:—

(i) Technical and Professional Training, p. 294.
(ii) Replacement of Empirical by Rational Methods, p. 294.
(iii) Interdependence of various forms of Knowledge, p. 295.
(iv) Technical High Schools and Universities, p. 296.
(v) Characteristic of the University, p. 296.
(vi) Characteristic of the Technical High School, p. 296.

The remarkable teaching power of many Continental Universities and Technical High Schools is a feature that must strike every educationist who sees them. In order to give some idea of the matter, the Report gives explicit information, to which reference may now be made.

The teaching-staff of the *Institut National Agronomique* and their subjects are quoted in full (Chap. XLIV, secs. 4, 5, pp. 586–7.) The number of Professors in various subjects in the Berlin Agricultural High School are also given (Chap. XL, sec. 7, pp. 521–2).

This will sufficiently indicate the teaching power of agricultural schools. For Technical High Schools, those of Munich and Zurich may be taken as illustrative.

The contrast in efficiency with our University system is so startling that the case for the "*Technische Hochschule zu München*" is given in detail.

The Teaching-staff in the *General Division* consists of the following professors and lecturers, viz.:—

One ordinary professor in each of the following subjects, viz.:—Æsthetics and History of Art; Descriptive Geometry and Kinematics; National Economy, Statistics and Political Economy and Bavarian Political Law; Geography, Experimental Physics; and History.

For Mathematics there are 2 ordinary professors, and the "extraordinary" professors are 1 each for the following, viz.:—Technical Physics, German History, Universal and German Literature.

The Honorary Professors are:—Physics, 1; Geography, 1; Romanic Languages, 1. Military Education has 2 professors. The *Privat-dozenten* are:—History of Art, 2; Physics, 1; Physics and Meteorology, 1; History of Descriptive Natural Science, 1; Pure and Applied Mathematics, 1. With a Gymnasial Professor this makes a total of 20.

In the *Civil Engineering Division* there are the following professors, viz.:—

Engineering Science, 3; Geodesy and Topography, 1; Geodesy and Engineering Science, 1 *Privat-dozent*; total, 5.

In

In the *Architectural Division* there are—

Professors of Architecture, 3 ; Theory of Architectural Form, Perspective and Interior Decoration, 1 ; Civil Engineering Construction, 1 ; Plastics, 1 ; Theory of Construction and of Materials of Construction, 1 ; Freehand Drawing and Water-colour Drawing, 1 ; Agricultural Architecture and Engineering, 1; total, 9. The last three are extraordinary, the former ordinary, professors.

In the *Mechanical Engineering Divison* there are the following professors, viz. :—

Mechanical Technology and Mechanical Construction, 1 ; Applied Physics, 1 ; Theory of Engineering Construction, 1 ; Machine-construction, 3 ; Mechanics, 1 ; Electro-technics, 2 ; Applied Thermodynamics, 1 ; Professor of Mechanical Construction, 1 ; total, 11. The last is an extraordinary professor.

The teaching-staff of the *Chemical Division* consists of the following, viz. :—

Professors —Mineralogy and Geology, 1 ; Chemical Technology with Metallurgy and Mining, 1 ; Chemistry of Fermentation, 1 ; Analytical and Applied Chemistry, 1 ; Inorganic Chemistry, 1 ; Honorary Professor, Geology and Palæontology, 1 ; Privat-dozenten, General Chemistry, 2 ; Electro-chemistry, 1 ; Hygiene, 1 ; Geology and Palæontology, 1 ; Mineralogy and Geology, 1 ; Physical and Inorganic Chemistry, 1 ; also one extraordinary professor from the University Staff ; total, 13,

In the *Agricultural Division* there are :—

Professors, Agriculture, 2 ; Agricultural Chemistry, 1 ; Theory of Animal Nutrition, etc., 1 ; Extraordinary Professor, Agriculture, 1 ; Honorary Professor, Special Botany, 1 ; total, 5.

The teachers of the *General Division* are :—

Gymnasial Professor, French Language and Literature, 1 ; Privat-dozent, English Language and Literature, 1 ; Italian Language and Literature, 1 ; total, 3.

Engineering Division, Technical, Plan, Chart, and Cadastral Drawing, 1 ; total, 1.

The " Assistants " of the *General Division* are :—

Physical Institute, 3 ; Higher Mathematics, 1 ; Descriptive Geometry, 3 ; Technical Physics, 1 ; total, 11.

In the *Civil Engineering Division* there are :—

Engineering Science, 3 ; Geodetical Institution, 3 ; total, 6.

The " Assistants " of the *Architectural Division* are :—

Building Design, 1 ; Theory of Building Construction, 1 ; Theory of Architectural Forms, Shadow Construction, and Perspective, 1 ; Higher Architecture, 1 ; one occasional assistant for Architectural Drawing ; total, 5.

In the *Mechanical Engineering Division* there are :—

Laboratory for Technical Mechanics, 1 ; Mechanical Construction, 4 ; Laboratory for Electro-technics, 3 ; Theory of Engineering Construction, 1 ; Sub-Assistant for Engineering, 1 ; Sub-Assistants, Laboratory for Electro-technics, 2 ; Volunteer Assistants, Laboratory for Electro-technics, 2 ; Assistant for Electro-technics, especially for Practice in Electro-technical Construction, 1 ; Technical Mechanics, 1 ; total, 16.

In the *Chemical Division* there are :—

Chemical Laboratory, 5 ; Electro-chemical Laboratory, 1 ; Mineralogy and Geology, 1 ; Laboratory for Technical Chemistry, 1 ; Laboratory for the Chemistry of Fermentation, 1 ; Inorganic Chemistry, 1 ; total, 10.

In the *Agricultural Division* the " Assistants " are :—

Agricultural Central Experimental Station, 3 ; Laboratory for Chemical Agriculture, 1 ; Agricultural Laboratory and Experimental Field, 1 ; total, 5.

Outside

Outside the teaching staff of the Technical High School the following assist in the course of instruction, viz. :—

A Professor of Physiology and one of Botany in the University; a Professor of Botany, one of Epidemics, one in Comparative Anatomy, Embryology, and the History of the Development of Domestic Mammals, all from the Veterinary High School; a "Direktionsassessor" of the State Railways for Electro-technics; an Agricultural Engineer of the Hydrotechnical Bureau in the Royal State Ministerium for the Interior for Agricultural Amelioration; the Director of the Royal Moor Cultivation Institution for Moor Cultivation; a Privat-dozent, "Observator" for the International Geodesy Commission for Calculation of Probabilities and for Spherical and Theoretical Astronomy; total, 9.

The above gives a grand total of 108. If thorough teaching is of any real value, it is impossible to fail to recognise the great disparity between such staffing as the above, and that with which we are familiar; and it is quite certain that we cannot possibly reach the excellence of the German system without similar specialism and thoroughness in regard to the personnel. The liberal staffing which is characteristic of the Universities and great technical high schools of Europe, may be further illustrated by a reference in the Report to the professors, assistants, *Privat-dozenten*, of the Federal Polytechnicum of Zurich, and their courses. [*See* Chapter XXXIII, section 12, pp. 348-354.]

"Is such teaching power necessary?" may be asked. The verdict of the more highly educated nations is unquestionably in the affirmative; and it is believed that the better the education is the better it pays.

10. *Equipments of Scientific and Technical Laboratories.*—Another feature, no less striking than the great teaching power of modern technical high schools, is their lavish scientific and technical equipment. This is designed to meet two requirements, viz. :—(1) Suitability for teaching purposes; (2) Utility in scientific and professional investigations.

It would serve no useful purpose to give a long technical account of these. From the practical exercises in the physical and electro-technical laboratories of the Charlottenburg Technical High School, one gets at once some conception of their excellence [Chap. XXXI, sec. 14, 15, pp. 314–7]. The account of the "laboratory and general equipment" of the Munich Technical High School, will also give an idea of the extent of modern equipments [Chap. XXXII, sec. 3, p. 320]. Reference is further made in the Report to various other equipments [Chap. XXXIII, sec. 13, p. 355, Chap. XXXIV, sec. 3, pp. 356–7; sec. 19, p. 362].

In America, the laboratories, etc., are often very complete, hence detailed accounts have been given of their equipments—for example, that of the Massachusett's Institute of Technology, Boston; of the Stevens' Institute of Technology, Hoboken; of the University of California, Berkeley; of the Cornell University, Ithaca; of the Pennsylvania University, Philadelphia.

Equipments of America Higher Technical Schools and Universities.

Massachusetts' Institute of Technology, Boston, Chapter XXXVI.—Mechanic Arts, sec. 32, p. 423; Chemistry, Kidder laboratories of inorganic and organic chemistry, sec. 33, p. 423; Roger's laboratory of Physics, sec. 34, page 423; Electrical Engineering laboratory, sec. 35, pp. 423-4; Civil Engineering and Surveying laboratory, sec. 36, p. 424; Hydraulic laboratory, sec. 37, p. 424; Steam laboratory, sec. 38, p. 425; the five John Cummings laboratories of Mining Engineering and Metallurgy, sec. 39, p. 425; Biological laboratories, sec. 40, p. 426; Mineralogical laboratory, etc., sec. 41, p. 426.

Steven's Institute of Technology, Hoboken, Chapter XXXVII.—Laboratory equipments, sec. 7, pp. 431-2.

University of California, Berkeley, San Francisco, Chapter XXXVIII.—Details of various laboratories, secs. 10 and 11, pp. 442-3.

Cornell University, Ithaca, New York State, Chapter XXXVIII.—Equipment and apparatus, sec. 20, p. 447; Hydraulic laboratory, sec. 21, pp. 447 8; Cement laboratory, sec. 22, p. 448; Geodetic laboratory, sec. 23, p. 448; Metric laboratory, sec. 24, p. 448; Laboratory for testing materials of construction, sec. 25, p. 449; Photographic laboratory, sec. 26, p. 449; Barnes' Astronomical laboratory, sec. 27, p. 449; Museums of civil engineering, sec. 28, p. 449; Sibley College and its equipment, sec. 29, pp. 449-450; Mechanical laboratories, Sibley College, sec. 30, p. 450; Electrical Engineering laboratories, sec. 31, pp. 450-1.

Pennsylvania University, Philadelphia, Chapter XXXVIII.—Equipment of laboratories, sec. 54, p. 462.

During

During the time the Commissioners were travelling, large additions to technological and scientific laboratories were being made, not only in Continental Europe, but also in the United Kingdom and in America. Many large manufacturing firms present the various laboratories with material, often of considerable value, or send new apparatus for testing or general experiment to the high schools.

Although, to the casual visitor, the Sydney University might seem to be well equipped for scientific and professional teaching and investigation, in reality it is not so, if average European standards of comparison be adopted. If the scientific work is to have vitality, a considerable and increasing amount of money must necessarily be made available for professional and purely scientific research. The progress of the higher branches of education, and also of the industries that really depend thereupon—that is, that depend upon the extensions of human knowledge—necessitate large expenditures for equipments and maintenance. The next section or two will refer to German progress in this respect.

11. *Expenditures on Higher Technical Education.*—The rapidly-growing power of Germany is, as previously stated, clearly attributable, not remotely but directly, to her magnificent educational system. Her outlay for *every* branch of education is large; that for universities, higher technical schools, and for higher education generally, is very lavish and occasionally colossal. For example, the outlay for the main buildings of the technical high schools at Berlin, Hanover, and Aachen, at the time they were constituted high schools, was as follows, viz.:—

Berlin, £485,000; Hanover, £79,000; Aachen, £137,500.

The new buildings (1902–3) at Dresden cost £250,000; the cost of erection of the Danzig school will be £200,000; the new buildings at Darmstadt (1896) cost £150,425; in 1903 the extensions thereto amounted to £42,847, and now (1904) there are further extensions representing £92,799—a total of £286,071 for Darmstadt alone.

The building site for the Breslau school was given by the municipal authorities there; the Prussian Diet gave £12,500; the Society of Metallurgists of Silesia, £25,000; private individuals, £11,500; in all, £49,000, not including the value of the site. At Karlsruhe, during the past six years, the extra expenditure for apparatus, new buildings, etc., amounts to £128,681. At Stuttgart the "extraordinary expenditure"[1] for the Electro-technical Institute and Chemical Laboratory was £37,500 in 1895; Engineering Laboratory, £25,000 in 1899; new wing to main building in 1902, £26,000; in all no less than £88,500. The revenues, state aid, and *ordinary* total expenditure for 1902[2] for six non-Prussian technical high schools is as follows:—

	Revenue.	State Aid.	Total, *Ordinary* Expenditure.
	£	£	£
Brunswick	2,250	11,401	13,651
Darmstadt	18,966	9,941	28,907
Dresden	2,977	29,436	32,413
Karlsruhe	10,906	22,000	32,906
Munich	18,000	26,000	44,000
Stuttgart	7,051	19,391	26,442
Totals... ... £	60,150	118,169	178,319

It is to be borne in mind that this is for the technical high schools *only*, and does not include Universities, nor secondary nor lower technical schools.

12.

[1] "Extraordinary expenditure" covers buildings and their equipment, not ordinary expenditure for teaching, expenses of research, &c.

[2] The figures for Stuttgart are for 1901.

12. *Does Higher Technical Education Pay ?*—" Can such expenditures as the above be economically justified ? " may well be asked. The steady and powerful advance of Germany, commercially and industrially, is the answer to this. As an illustration, the effect of chemistry may be mentioned.

An idea of the values *created* by chemical science can be obtained from the following approximate estimate of the German dye industry alone, which, despite the decline of price to less than one-half in twelve years, is represented by the following figures, viz. :—

Estimated Value of Chemical Dye Industry, Germany.

Year	1874.	1878.	1882.	1890.	1898.
Estimated value	£ 1,200,000	£ 2,000,000	£ 2,500,000	£ 3,250,000	£ 6,000,000

The four leading dye-works paid between 1895 and 1899 between 12½ and 28 per cent. dividends.

Chemical science has shewn its immense value in agriculture in even a more conspicuous way. The minerals containing suitable salts are mined. Prussia, for example, began to mine for potassium salts in 1860. The total production for Prussia and Anhalt up to 1890 was £11,500,000, the value for that year being no less than £831,457. In 1898 this had risen to £1,485,715.

The enormous development of the beet-sugar industry through the direct assistance of chemistry to agriculture, and through the improvement of the yield from the beet, is illustrated in the following figures :—

Yield of Beet Sugar, Germany.

Year	1836–1840.	1841–1845.	1846–1850.	1851–1855.	1856–1860.	1861–1865.	1866–1870.	1871–1875.	1876–1880.	1881–1885.	1886–1890.	1895.	1899.
Beet treated in 1,000 tons	154	203	495	995	1,569	1,934	2,540	3,176	4,679	8,282	8,722	11,018	12,811
Percentage of sugar obtained.	5·72	6·49	7·22	7·74	8·17	7·98	8·30	8·53	8·93	10·65	12·73	12·13	13·00
No. of works	147	106	142	227	248	262	297	327	328	377	397	401	400

Germany exported about £11,000,000 of beet-sugar annually between 1890 and 1898.

The production of superphosphate of lime in Germany will also shew how chemistry is aiding agriculture.

Production of Superphosphate in Germany.

Year	1867.	1872.	1883.	1899.
Tons produced	1,000	7,000	400,000	750,000, for which 400,000 tons of sulphuric acid were required.

The

The ground slag of the Thomas-Gilchrist steel process is used for manuring purposes. The production is as follows :—

Ground Slag as Manure.

Year	1886.	1887.	1890.	1899.
Tons produced	25,000	50,000	500,000	900,000. Of this, 100,000 tons were exported; value, £180,000.

Germany uses annually over 2,000,000 tons of artificial manures, valued at about £5,000,000.

It may be mentioned that German chemical works pay from about 5 to 28 per cent; a very large number pay over 12 per cent.

The results must be taken merely as significant illustrations. That the agricultural benefit is enormous can readily be supported by local results,[1] and this is, of course, due to scientific and technical progress.

The recent astonishing progress of electrical and industrial works, the expensive failures which have been met with in electrical engineering, for example, through scientific and technical ignorance, have sufficiently demonstrated the fact, not only that higher technical education pays, but also that it is absolutely essential.

13. *Conditions under which the higher technical teaching staff works in other countries.*—The teachers in the highest grade of technical instruction, and in universities, ought to be men in the first rank of intellectual, technical, and professional attainment—in fact, the efficiency of the whole scheme of higher technical education depends upon this. Second-rate men ought, therefore, not to be employed in technical high schools and universities; the subtle personal influence of very able men is essential to the higher forms of progress. Hence the conditions of the teaching staff must *attract* the ablest men—not repel them.

It was publicly deplored in England that commercial, not academic, pursuits attracted the best men, because academic conditions were not satisfactory.[2]

The method by which able men are secured for higher technical teaching in Europe and America is to permit them to hold several professorships or lecturerships, for which they are competent, or to hold their academic positions in connection with a general or sometimes only with a consulting practice or other occupation. Such a method is necessary, not only to secure sufficient emoluments to retain the services of capable men, but also to maintain efficiency. A technological expert or a professor in architecture, or in engineering, for example, who was solely academic, would lose practical touch with the developments of technology of architecture or of engineering. For the maintenance of technical efficiency it is requisite, in the majority of cases, to keep direct touch with professional practice.

There

[1] The following experiments by Mr. Henry Lord, Lecturer in charge of the Department of Agriculture in the Technical College, shew the value of manuring. In every case manure was used at the rate of £1 16s. per acre :—

Kind of Potato.	Yield without Manure per acre.			Yield with Manure per acre.		
	tons	cwt.	qrs.	tons	cwt.	qrs.
Early Victor	5	2	2	10	16	3
Blue-eyed Russett	4	19	1	12	1	0
?	5	17	2	16	19	1
Early Victor ⅔, + Bushman ⅓	5	13	2	13	15	1
Manhattan	5	16	3	14	1	2

The average yield in New South Wales is under 3 tons per acre. Mr. Lord was educated in France.

[2] Men of the highest ability hesitate to enter upon an academic career because of its limited outlook financially. Sir William Ramsay, F.R.S., recently drew attention to the fact that the real academic emoluments of some of the more distinguished German professors amounted to £5,000 to £7,000 per annum, notwithstanding the impression that they are poorly paid. Inquiry made by the Commissioner as to what salary would be required by a good technological and educational expert, revealed the fact that a salary of £4,000 per annum was *inadequate*.

There is still another aspect of the matter which demands attention. If teachers in higher technical schools are men of the proper calibre, their services as experts ought to be available to the public in the usual way—that is to say, ought to be obtainable for a consideration. That view is clearly recognised and acted upon throughout Europe and America.

Only by ensuring satisfactory conditions for the service of higher technical instructors can an able teaching staff be secured, for high efficiency means long years of ardent pursuit of one's specialty, and the accumulated stores of knowledge of the expert ought to be exploited, not only by his students, but also by the world at large.

14. *General Remarks.*—In reviewing higher technical education in this State, as a whole, it must be obvious that it can only advance to its normal place after the whole plane of public education has been raised to the European level.

Individual excellencies in part of our equipments, or in certain members of the various professorial bodies, will not compensate for absence of that thorough organisation through which such magnificent education excellence is attained in Europe.

Dr. Carl Peters says, referring to our educational system:—

> *What is wanting is plan and method, such as exist in our educational establishments.* Wherever a German student may follow his avocation, he will reach practically the same level of general knowledge and special acquirements, simply because the State prescribes a uniform standard of examinations for all Universities. In Great Britain everything varies individually and locally. Practical chemistry and higher technics have more and more passed under German guidance. Men of intelligence have noticed this for a long time, and acknowledged the reason of such retrocession, and the desire to follow German methods increases daily in the matter of education no less than in the army.[1]

From personal observation, and protracted study, extending now over more than a decade, I am convinced that this verdict is substantially just, and hence the matter deserves our most serious attention, so that our system of higher technical education may be advanced.

---

[1] England and the English, pp. 267-8.

XX.

GENERAL REVIEW OF HIGHER TECHNICAL EDUCATION IN GERMANY.

[G. H. KNIBBS.]

1. *Explanatory.*—It is quite impossible to give any adequate idea of higher technical education, as it is organised in various countries throughout the world, in the compass of this brief summary. To get even a general idea of any value, reference must be made to the passages, already referred to, in the body of the Report. All that is here proposed is to focus attention on a few features, and to contrast the thoroughness of the methods of some countries with the superficiality of others, and to do this it will be necessary to present an outline of the magnificent system of technical education in Germany.

2. *Technical High Schools of Germany.*—At the head of the scheme of technical education in Germany stand the Technical Universities, which are variously known by the names "*Technische Hochschule*"; "*Polytechnikum*"; "*Polytechnische Schule*"; the latter two being the earlier designation of the schools. Notwithstanding similarity of name, the grade of instruction in these is not to be confounded[1] with that in the Polytechnics of London, which are a much lower type of school.

Owing to the excellent secondary school preparation which is demanded, as a condition of entrance, the work is commenced on the plane of German university work, and consequently is not only far more advanced than the work in the London Polytechnic, but is also more advanced and more thorough than that to be found even in the universities of the United Kingdom, a point which will be reverted to later on. It may be said, without reservation, that it is not possible to attain to the educational excellence of these institutions without undergoing a very far-reaching educational reform,[2] for they are the pinnacles of an education system, the organisation and thoroughness of which is almost ideal, however much elementary features in the system may require modification. Thorough preparation is not possible without such organisation, for in the scheme—if scheme it can be called—of the United Kingdom, and of this State, the fitness of the student has to be ascertained by special entrance examinations, which are necessarily limited in range, and for which a great deal of cramming has to be done.

Moreover, not only has the German student been better taught, he is educationally far more matured than the English or New South Wales student; and as pointed out, in Division XIX of this Summary, he is allowed some responsibility of choice as regards attendance on the courses of instruction.[3] The

[1] Very erroneous ideas prevail here in regard to these; the impression existed in the Department of Public Instruction that the technical colleges of this State were institutions of an analogous character, and the Commissioners were so informed before leaving the State. But organised courses of the Technical College are not anything like equal even to the courses in the *Technikums*, let alone those of the technical high schools.

[2] Dr. F. Rose, His Majesty's Consul at Stuttgart, deplores the fact that our countrymen lose their "opportunity of gaining an insight into *an almost perfect system of higher technical instruction.*"

[3] The only conspicuous defect in his preliminary training is probably the absence of manual training. But neither in the United Kingdom nor here is this better attended to.

The large number of technical high schools in Germany is worthy of remark, they are of course exclusive of the Universities on the one hand, and a great number of secondary and lower technical schools on the other. Most of the schools were originally trade or technical schools, they then became polytechnics, and finally technical high schools, *i.e.* Universities for technical education. The following is a list:—

Technical High Schools of Germany.

Locality.	Founded.	Became Polytechnic.	Became Technical High School.	Locality.	Founded.	Became Polytechnic.	Became Technical High School.
Aachen	......	1870	1880	Dresden ...	1836	1871	1890
Berlin [1]	1821	1879	1882	Hannover ...	1831	1847	1880
Braunschweig ...	1853	1862	1878	Karlsruhe ...	......	1825	1867
Breslau	......	......	1906 [2]	München ...	1827	1864	1877
Danzig	......	......	1903	Stuttgart ...	1829	1840	1870
Darmstadt ...	1836	1869	1883				

At the time of their foundation these schools were intended for the study of architecture, engineering, and mechanical technology: they were "practical" and paid attention to the merely empirical aspects of the subjects. As education progressed, however, the empirical gave place to the rational aspect; higher mathematics, drawing and designing, the theory of the subjects, entered into the curricula. As time went on, the place assigned to the higher elements commanded more and more prominence, and completely-equipped divisions were created for chemistry and chemical technology; physics and its applications in electricity, etc., various branches of engineering, naval architecture, surveying, forestry, and similar subjects, together with such general subjects as languages, political economy, etc., etc.

These are not the sole sources of technical knowledge in Germany. In the Universities of Jena and Marburg, chemistry was taught as far back as the early part of the 17th century. Göttingen University was the first to offer lectures on technical chemistry; the Universities of Jena, Erfurt, Berlin, Tübingen, Heidelberg, and Breslau offered courses both in pure and applied chemistry from a very early date. Although chemistry still flourishes at the universities, the instruction in chemical technology is usually far more thorough and advanced in the technical high schools.

3. *Administrative Organisation of the German Technical High School.*—Since the reorganisation under their present title, the *Techische Hochschulen*, are essentially Technical Universities, *with the powers of self-government by the professorial staff*, subject only to a liberal control by the Ministry of Education [*Ministerium der Geistlichen, Unterrichts und Medizinal Angelegenheiten*]. Each school is divided into departments [*Abteilungen*] corresponding in number and designation with the branches of applied science, or technology, represented therein. By this arrangement, which is perfect from the standpoint of organisation, both in respect of efficiency and economy, each department had certain special elements complete in themselves; while each stands in relation to every other department, mutually assisting and supplementing its work.

This organisation is obviously much more advantageous than the development of monotechnical schools. In this respect the organisation is identical with the scheme of the various universities of the world, but it is incomparably more efficient, because the sciences are technologically orientated, and the educational effort is specialised after an excellent general education as a preparation.

The head of the technical high school is a Chancellor, or, rather, a Rector (*rector magnificus* in the Prussian schools). In some instances there is also a Vice-Chancellor, or *Pro-rector*. The departments are governed by Councils,[3] consisting of the fully qualified professors (*ordentliche Professoren*), who are presided over by a Dean, or President, elected by them.

The

[1] Charlottenburg, a suburb of Berlin.
[2] Not yet completed.
[3] Somewhat similar to, but by no means identical with, the "faculties" in the University of this State.

The Senate consists of the Rector, Pro-rector (if there be one), deans, or representative heads of departments, and sometimes nominated professors, either "fully-qualified" or otherwise. As the constitution of the Senate is not always identical, examples are given.

In Berlin the Senate consists of the presiding officers of the Councils of each department.[1] The Rector is elected by all "fully-qualified" professors and holds office for one year, but at Aachen and Hannover for three years. At Stuttgart he holds office for one *or* two years; at Karlsruhe one year. The election has to be ratified in the following ways:—By the King of Prussia for Berlin; by the Prussian Minister for Education for Aachen and Hannover; by the Grand Duke of Baden for Karlsruhe; by the King of Württemberg for Stuttgart, etc.

The Senate and its variations are several. At Karlsruhe there is a Senate, consisting of the Rector, Pro-rector, presiding heads of departments, and a professor nominated by the "Upper Council," the latter consisting of *all* "fully-qualified" professors, and "extraordinary" professors, nominated by the Ministry of Justice and Education. At Darmstadt the Upper Senate consists of the Rector, Pro-rector, and the presiding heads of departments, and the Lower Senate of all "fully-qualified" professors. In Stuttgart a body similarly constituted to the Upper Senate of Darmstadt is known as the Senatorial Council. At Karlsruhe one professor nominated by the "Upper Council" has a seat on the Senate, while the "Upper Council" consists of all "fully-qualified" professors and such other professors.

There are usually advisory committees to deal with building, economic, and legal questions; a secretarial office, and treasury.

4. *Teaching Staff of German Technical High Schools.*—The various grades of teachers are as follow, viz.:—

(1) "Fully-qualified" or ordinary professors (*ordentliche professoren*) in Prussia are of 4th rank among State officials; in Würtemberg, of 6th rank; they are appointed for life.

(2) Extraordinary professors (*ausserordentliche professoren*) are in rank as State officials one place lower than the former; can be dismissed comparatively at short notice, but frequently become "ordinary professors."

(3) Lecturers (*Dozenten*) are paid by the State, usually according to the number of lectures given; they are often engaged at other institutions, and frequently become professors. The title "professor" is sometimes conferred upon them.

(4) Private lecturers (*Privatdozenten*) are lecturers who are permitted by the academic authorities to give lectures; they receive the greater portion of the lecture fees; may have the title "professor" conferred upon them, and frequently become extraordinary or ordinary professors.[2]

(5) Assistants (*Assistenten*) are often engaged by the professors, but they may be permanent (*ständige*).

Besides these there are:—

(6) Honorary professors (*Honorarprofessoren*), and

(7) Instructors (*Lehrer*).

The statutory salaries are small, being usually less than £100 per annum, but the actual emoluments may amount to more than ten times this amount, in fact may reach from £4,000 to £7,000 per annum for men of special eminence.

Pensions are granted to all definitely engaged *Professoren* and *Dozenten*, the amounts varying, however, in different German States, being, as a rule, more favourable where the salary is lower.[3] An

---

[1] This is not quite analogous to the Deans of the various Faculties, for many departments are included within a faculty

[2] The teaching power of a university or technical high school can be greatly reinforced by following the example of Germany in this respect.

[3] In Württemberg the pension is as follows:—

After service of	10 years,	40	per cent.	of last salary drawn.
,,	20 ,,	60	,,	,, ,,
,,	40 ,,	90	,,	,, ,,

An ordinary professorship is rarely attained before 45 years of age, and the limits range between 44 and 56 as a rule. It may be mentioned, *en passant*, that the authorities of the Sydney University hesitate to appoint candidates of over 40 years of age to the professorial staff ![1]

It is obvious that the experience and training obtained in the period during which the lower office of *Dozent* is held, is invaluable for the more responsible post of "*ordentlicher Professor*," and that with the opportunities afforded for forming a judgment of any candidate's capabilities, the selection for such posts has greater probability of being well-made.

There are on the average about ten or twelve students to one member of the teaching staff. For the winter semester, 1901-2, there were the following students in the German universities and technical high schools, excluding those in agricultural, forestry, veterinary, and mining high schools :—

Students receiving higher form of Education in Germany, 1901-2.

	Fully qualified.	Others.	Total.
Universities	35,583	9,336	44,919
Technical High Schools ...	12,554	2,421	14,975
Totals	48,137	11,757	59,894

The numbers now are much larger, but even at the rate quoted we should have about 1,500 students in our university alone, since it combines not only university work, but also higher technical instruction.[2]

5. *Attendance of Foreign Students in German Higher Technical Schools.*—The total attendance of students in German higher schools of a technical character for 1902, was as follows, viz. :—

Attendances in German High Schools, 1902.

Type of High School.	No. of Schools.	Students.		Foreigners.	
University	22	43,899		2,917	
Technical	9	14,986	19,875	2,489	3,228
Veterinary	5	1,414		45	
Agricultural...	4	1,244		156	
Commercial	3	1,137		195	
Forestry	5	244		39	
Mining	3	850		304	
Totals	51	63,774		6,145	

Hence foreigners number $16\frac{1}{2}$ per cent. of the higher technical students, and about $9\frac{2}{3}$ per cent of the total, including the University. It has been estimated that each high school student costs the German States about £12 per annum. This makes the cost

[1] The German scheme of securing efficiency in the professorial staff is incomparably better than that of the University of Sydney. The selection by a committee in England of persons for a life professorship, is by no means a satisfactory method. The matter will be referred to later.

[2] The work done in the Technical College and Hawkesbury Agricultural College is not *higher* technical, but lower secondary only, and therefore should not be taken into account.

cost to Germany of educating foreigners for the technical high schools alone no less than £29,868. Probably £60,000 would be about the total. The percentage of English students is very low, of Russian very large,[1] due in the latter case to the fact that the conditions of student life in Germany are incomparably better than they are in Russia.[2]

There has been some comment in Germany as to the number of foreign students and some urging of restriction, but the powerful party is averse to hindering the advance of knowledge from national considerations, and adopts the motto "*Germania docet*," being quite prepared to bear part of the cost of educating foreigners, an attitude which has officially been favourably commented upon.[3]

6. *The Departments in German Technical High Schools.*—The following statement gives, in a tabular form, the different completely organised branches (*Abteilungen*) of technical instruction to be found in the various German Technical Universities, as well as the duration of the full courses in each:—

Fully Organised Courses in the Technical High Schools, Germany.

	Aachen.	Berlin.	Braunschweig.	Breslau.[4]	Danzig.[4]	Darmstadt.	Dresden.	Hannover.	Karlsruhe.	München.	Stuttgart.
Agriculture	...	...	...	...	...	...	...	...	..	3	...
Agricultural Engineering	...	...	...	...	...	...	...	...	...	4	...
Architecture...	4	4	4	...	...	4	4	4	4	4	$3\frac{1}{2}$
Civil Engineering	4	4	4	...	...	4	$4–4\frac{1}{2}$	4	4	4	4
Surveying Engineering	...	...	...	...	...	...	...	...	...	2	...
Surveying	...	...	...	...	..	1	...	...	...	...	...
Higher Surveying	3	...	...	...	...	...	...	...	...	...	...
Geodetical Engineering	...	...	..	...	...	...	3	...	...	...	...
Mechanical Engineering	4	4	4	...	?	4	4	4	4	4	$3\frac{1}{2}$
Textile Mechanical Engineering ...	3	...	3	...	...	...	...	...	...	...	...
Electrical Engineering	3	4	$3\frac{1}{2}$	...	?	4	4	...	4	4	4
Electro-chemistry	4	...	...	...	...	4	...	...	...	...	...
Electro-technical Science	...	...	...	...	...	...	...	4	...	...	...
Mining Engineering...	3-4	...	...	...	...	...	...	...	...	...	...
Metallurgy	3–4	...	...	...	...	...	...	...	...	...	3
Chemistry and Metallurgy	...	4	...	...	...	...	...	...	...	...	...
Chemical-technical Science	...	...	...	...	...	...	...	4	...	...	...
Chemistry	3–4	...	4	...	?	4	4	...	4	4	3
Pharmacy	...	...	$1\frac{1}{2}$	...	...	$1\frac{1}{2}$	...	...	$1\frac{1}{2}$	...	$1\frac{1}{2}$
Naval Engineering	...	4	...	...	?	...	...	...	...	...	...
,, Architecture	...	4	...	...	?	...	...	...	...	...	...
Hydraulic Engineering	...	...	...	?	...	...	...	...	...	...	...
Forestry	...	...	...	...	...	...	...	...	$3\frac{1}{2}$	...	...
Commercial Science	2	...	...	...	...	...	...	4	...	...	...
Mathematics...	...	...	...	...	...	...	?	...	...	...	?
General Science and Art	...	...	...	...	...	...	?	...	...	...	?
General Science subjects	?	?	...	...	...	...	...	...	2	?	?

Looking through the above table it will be evident, firstly, that there is by no means any attempt at moulding the technical high schools on the one model; secondly, that there are a great variety of fully-developed courses.

The pharmacy course of $1\frac{1}{2}$ years, and the courses in elementary surveying and engineering surveying, 1 and 2 years respectively, are the only short courses in professorial subjects.

The other courses are of 3 to 4 years' duration. 7.

---

[1] The total fully qualified students for 1902 is as follows, viz., Berlin 12 per cent.; Braunschweig, 15 per cent.; Darmstadt, 25 per cent.; Hannover, 10 per cent. Out of a total for four schools of 892 foreign students, Russia claimed 347 students, the United Kingdom only 16!

[2] Austro-Hungary has 7 technical high schools with, say, 5,300 students, and an attendance of 28 foreign students. On the other hand Germany has 9 technical high schools with nearly 2,500 foreign students. The inference is obvious.

[3] Dr. F. Rose, British Consul at Stuttgart, points out that, excepting in cases of overcrowding, no "difference is made between German and foreign students, either on the part of the academical authorities or of the professorial staff, a fact which," he says, "redounds most highly to the credit of the German educational authorities." See Dipl. and Cons. Rept. No. 591 Misc. Ser., May, 1903, p. 57.

[4] The Technical High Schools of Breslau and Danzig are in course of construction.

7. *Higher Mining Instruction in Germany.*—In the preceding list of Technical High Schools it may be noticed that Aachen is the only place where instruction in mining engineering is given; metallurgy is included in the courses at Aachen and Stuttgart; and chemistry and metallurgy in those at Berlin. But besides these, there are special Mining Schools, the leading ones being the following, viz.:—

Schools for Mining, Mine-Surveying, and Metallurgy, Germany.

Locality.	Title of School.	Founded.	Reorganised.	Became High School.
Aachen	Technical High School	......	......	......
Berlin	Mining High School	1770	1860[1]	1875
Clausthal	Mining Academy	1775[2]	1864	......
Freiberg	Mining High School...	1765	1871	1898[3]

The conditions of entrance are very similar for all,[4] viz., the *Abiturium* of a Gymnasium, Realgymnasium, or Oberrealschule, and an age of at least 18 years. In Berlin proof of practical work for 1 year is required; at Clausthal 6 months. At Freiberg a practical mining preparatory course is held every year from Easter to the end of July. Those who take up metallurgy are required to have 6 months experience in ironworks and to devote first vacations in same way.

The thoroughness of preparation may be illustrated by the work of the highest class of the three schools above mentioned.

Highest Class of the Three Secondary Schools.

Subjects.	Hours per week. G.[5]	R.G.[5]	O.R.[5]	Subjects.	Hours per week. G.[5]	R.G.[5]	O.R.[5]
Religion	2	1	1	Mathematics	3	...	...
German	3	2	2	Analytical geometry	...	3	3
Latin	7	5	...	Descriptive geometry	...	3	3
Greek	6	...	...	Higher analysis...	...	4	3
French	2	3	4	Trigonometry	...	...	2
English	...	2	3	Physics	...	3	2
History	2	2	2	Chemistry	...	...	1
Gymnastics	2	2	2	Freehand drawing	...	2	3
Psychology and logic	2	1	1	Architectural drawing	...	2	2
Mineralogy and geognosy ...	2	2	2	Geography and astronomy ...	1	...	...

The teaching power of three of the institutions is as follows:—

Teaching Staff of Mining Schools.

	Ord. Prof.	Extr. Prof.	Dozent.	Assist.	Total.	Students to 1 Professor.
Berlin	16	10	2	3	31	9
Clausthal	8	5	...	6	19	12
Freiberg	16	10	2	3	31	14

8. *Equipments of the Higher Mining Schools of Germany.*—The equipments are specially worthy of mention. *Freiberg* has a *library* of 40,000 volumes; 350 manuscripts; 1,600 maps and drawings; *Clausthal* has 30,000 volumes. *Freiberg* has a chemical, a physical, and an electro-technical laboratory; an iron-testing laboratory; a general metallurgical laboratory; a blow-pipe testing laboratory. The collections are mineralogical, geological, palæontological, mineral deposits, mechanics, mining engineering, metallurgy (mainly models), chemical, metallurgical products, mine-

[1] Combined with State Geological Institute, 1873.

[2] This is the date of separation from the *Lyceum Clausthaliensis*, a Latin school. From 1811 to 1844 it was combined with a Forestry School. In 1852 became a 3-year institution, and acquired its present name in 1864.

[3] Was raised to rank of high school in 1898—its present constitution dates from 1901.

[4] Clausthal at present admits with the certificate of one class below the final class in the three higher secondary schools.

[5] G. denotes Gymnasium; R.G., Realgymnasium; and O.R., Oberrealschule.

mine-surveying instruments, mathematical models, physical apparatus, mechanical technology, salt-work ; special collection for metallurgy of iron. Special features of the laboratories are apparatus for survey work, mine-surveying, volumetric and technical gas analysis, investigation of gases forming in mines, apparatus for pyrometry and calorimetry, for determination of minerals, microscopic investigation of rocks, minerals, petrology, etc.

The equipment at *Berlin* is still more complete. The Library had, in 1903, about 65,000 volumes, about 800 being added yearly ; and had also about 2,200 maps, drawings, and plans, about 150-180 being added yearly.

The mineral collections are two principal collections, one collection for demonstration purposes, one collection for practical work, and a special collection with fine typical crystals and crystal models. This last is in a special room, to which students have continual access.

The geological collections embrace 14 divisions, one division alone filling no less than 12 rooms on the first storey of the principal building.

There is a fine collection, with more than 1,000 different objects, illustrating mining engineering, ore-dressing, salt-works, etc. This includes models, instruments, tools, machines, mining antiquities, various collections of raw and finished products. There are collections illustrating chemical technology, general metallurgy, the metallurgy of iron, and electro-metallurgy. The special museum of mining and metallurgy contains minerals, products, etc., from the German colonies and protectorates.

The divisions of the chemical laboratories are: Qualitative, quantitative, volumetric, gas, spectrum, electrolytic, and organic analysis, general testing, iron-metallurgical testing, soil-analysis.

In the mechanical workshop models, tools, small boring apparatus, etc., are manufactured.

9. *The Curricula of the Higher Mining Schools.*—The thoroughness of the work stands in such marked contrast to that undertaken in the courses of the University that the curricula are here outlined, not being given in the body of the report. Two examples will be sufficient, viz., the *Clausthal* curricula and the *Freiberg* curricula.

At Clausthal there is a *preparatory course of* 6 months, the students working from 6 a.m. to 12 a.m., spending the afternoons in elaborating an account of what they have observed, and how they have been occupied. They devote one month to ore-dressing; three months to mining, water conservation, supply, etc. ; and two months to metallurgy. Works and machinery are inspected ; methods of mining, ore-dressing ; metallurgical works, are examined, and practical work is undertaken. Great importance is attached to this experience as it intensifies the interest of the theoretical work afterwards, and leads to a clearer comprehension of its nature and purport.

Curriculum for Mining and for Metallurgy, Clausthal.

Year I.			*Year II.*		
Subjects.	Hours per week.		Subjects.	Hours per week.	
	Semester [1] I.	Semester II.		Semester III.	Semester IV.
Elementary Mathematics	3	2	Differential and Integral Calculus ...	4	4
Analytical Plane Geometry	3	...	Mineralogy	6	...
Analytical Geometry of Space ...	...	3	Practical Mineralogy...	4	...
Descriptive " "	4	...	Geology	2	6, 0 [2]
Physics	5	5	Practical Geology	...	6, 0
General Chemistry	6	5	Fuels	1	...
Fossils	2, 0 [2]	2, 0	Mechanical Theory of Heat	...	2
Mechanical Drawing	2	2	Blow-pipe Testing	3	...
National Economy	4	...	Practical work with Blow-pipe ...	0, 2	2
Civil Code	...	4	Mechanics	6	3
Administration...	...	3	Qualitative Chemical Analysis ...	0, daily	0, daily
Ambulance work	1	1	Practical Physics	2	2
Totals	30, 28	27, 25	Totals...	28, 30 +	25, 13 +

[1] The Semester is a half-year.
[2] Where two figures are given, thus,—0, 6, the former is for Mining, the latter for Metallurgy: similarly throughout.

Year III. Subjects.	Hours per week. Semester V.	Semester VI.
Mining Engineering	8, 0	...
Ore-dressing	...	6, 0
Surveying	6, 0	4, 5
Practical Surveying	...	4
General Metallurgy	0, 3	0, 3
Testing	0, 6 [1]	0, day
Mineral Deposits	1, 0	2, 0
Quantitative Chemical Analysis ...	0, daily	0, daily
Electro-technics	3	3
Microscopic Petrology	...	2
Totals	18, 12 +	21, 17 +

Year IV. Subjects.	Hours per week. Semester VII.	Semester VIII.
Quantitative Chemical Analysis ...	0, daily	...
Volumetric Analysis	...	0, 4
Mechanical Engineering, Machines, and Machine Construction ...	12	12
Chemical Industries	2	...
Mineral Deposits	1, 0	2, 0
Metallurgy of Iron	0, 2	0, 8
Mining and Metallurgical Design ...	2	2
Mining Law	4	...
Recapitulation of Metallurgy ...	...	0, 1
Practically Metallurgy	0, occas.[2]	...
Salt Works	...	1
Totals [3]	21, 22 +	17, 28

Where only the one number is shewn it is common to the two courses.

At Freibeig the first year is nearly identical for the course in Mining Engineering, Mining Surveying, Metallurgical Engineering, and Iron-metallurgical Engineering. The agreements and differences will be apparent in the following tables:—

Curriculum for Mining Engineering, Mine Surveying, Metallurgical Engineering, and Iron-metallurgical Engineering, Freiberg, Germany.

Year I. Subjects.	Hours per Week. Lectures.	Practical work.
Higher Mathematics	6	......
Descriptive Geometry	3	2
Algebra	2[4]	......
Physics	6	1
Mineralogy	5	......
Plan and Section Drawing ...	......	2
General Mining Engineering ...	0, 5, 5, 5	......
Inorganic Chemistry	4, 0, 4, 4	......
Crystallography	......	1, 0, 2[4] 0
Spherical Trigonometry	2[1], 2, 0, 0	......

Year II. Subjects.	Hours per Week. Lectures.	Practical work.
Higher Mathematics	2	......
Mechanics	6	......
Geology	5	......
General Mining Engineering ...	5, 0, 0, 0	......
Special Mining Engineering ...	0, 5, 0, 0	......
Machine Drawing and Design ...	......	2, 0, 2, 2
Blowpipe Analyses	2, 0, 2, 2	2, 0, 2, 2
Physics	......	2, 0, 2, 2
Crystallography	......	1[5], 0, 1[5], 0
Mineralogy	......	2, 0, 2, 0
Qualitative Chemical Analysis ...	0, 0, 1[5], 1[5]	0, 0, Daily, Daily.
Ore-dressing	0, 0, 5[4], 5[4]	......
Fossils	2, 0, 0, 0	......
Petrographic Determinations ...	......	2[4], 0, 0, 0
Mine Surveying and Geodesy ...	0, 3, 0, 0	0, 2[5], 0, 0, 6[4]

[1] Where two figures are given, thus :—0, 6, the former is for Mining, the latter for Metallurgy : similarly throughout.

[2] Occasionally—that is, whenever it is convenient.

[3] Obviously, the total hours per week exceed these "totals."

[4] Denotes that the course is for the Summer Semester only.

[5] Denotes that the course is for the Winter Semester only.

Mining Engineering.

Year III.

Subjects.	Hours per week. Lectures.	Hours per week. Practical Work.
Mine Surveying and Geodesy	3	6[1], 2[2]
Special Mining Engineering	5[2]	2[1]
Ore Dressing	5[1]	......
Briquette Making	1[2]	
Machinery	4	......
Mineral Strata	2	......
Metallurgy	4	......
Building Construction	3	......
Machine Drawing and Design... ...	......	4
Political and State Science	2[2], 3[2]	......

Year IV.

Subjects.	Hours per week. Lectures.	Hours per week. Practical Work.
Mine Surveying and Geodesy ...	3	6
General Law	4[2]	......
Mining	4[1]	......
Design Mining and Metallurgical Buildings	......	4
Ore Dressing	......	2[2]
Mining and Metallurgical Computation	1	......
Mining and Metallurgical Statistics...	1[2]	......
Electro Technics	2	2
Metallurgy of Iron	1[2]	......
Saltworks	1[1]	......
Mechanics—Metallurgical Technology	2	......
Special Mechanics — Metallurgical Technology	1[1]	......
Methods of Testing	1	......
Analysis of Mine Gases	......	?

Mine Surveying.

Year III.

Subject.	Hours per week. Lectures.	Hours per week. Practical Work.
Mine Surveying and Geodesy, ii	3	6
Occurrence of Minerals and Ores	2	......
General and Mining Law	4	......
National and State Economy	2[1], 3[2]	......

Metallurgical Engineering.

Year III.

Subjects.	Hours per week. Lectures.	Hours per week. Practical Work.
Metallurgy	4	......
Machinery	4	......
General Law	4[2]	......
Mining and Metallurgical Computations	1	......
Mining and Metallurgical Statistics ...	1[2]	......
Quantitative Chemical Analysis ...	2[1]	Daily.
Mine Surveying and Geodesy i ...	3	......
Building Construction	3	......
Machine Drawing and Design ii ...	......	4
Salt Works	1[1]	......
National and Political Economy ...	2[1], 3[2]	......

Year IV.

Subjects.	Hours per week. Lectures.	Hours per week. Practical Work.
General Mechanico metallurgical technology	2	......
Special...	1[2]	
Testing	1	half-day.
Volumetric Analysis	......	2[2]
Technical Gas Analysis	......	2[1]
Chemical Technology...	2	......
Metallurgy of Iron	4	......
Fuel, Firing, Stoking...	1	......
Electro Technics	2	2
Electro-metallurgy	1[2]	......
Mining and Metallurgical Construction Design	......	4
Pyrometry and Calorimetry	......	2[1]

[1] Denotes that the course is for the Summer Semester only. [2] Denotes that the course is for the Winter Semester only.

Iron—

IRON—METALLURGICAL ENGINEERING.

Year III. Subject.	Hours per week. Lectures.	Practical Work.	*Year IV.* Subject.	Hours per week. Lectures.	Practical Work.
Metallurgy of Iron	4	...	General Mechanico-metallurgical Technology	2	...
General Metallurgy	4	...	Special Mechanico-metallurgical Technology	1[1]	...
Elements of Machinery	4	..	Iron Testing	1[2]	...
Quantitative Chemical Analysis ...	2[1]	Daily	Volumetric Analysis	...	2[2]
Mine Surveying and Geodesy (i) ...	3	...	Technical Gas Analysis	...	2[1]
Building Construction	3	..	Iron Smelting Works...	1[2]	...
Machine Drawing and Design (ii) ...	...	4	Design, Mining, and Smelting Construction	...	4
Fuel and Firing	1	...	General Law	4[2]	...
National and State Economy	2[1], 3[2]	...	Mining and Metallurgical Computation	1	...
			Mining and Metallurgical Statistics...	1[2]	...
			Pyrometry and Calorimetry	...	2[1]

If these curricula be compared with the curriculum in mining and metallurgy in the earlier part of this summary [VI, §. 12] it might at first sight appear that the courses were comparable in academic thoroughness; but such is not really the case, and a close examination will disclose the fact that the German courses are competent to turn out thoroughly qualified men, while ours are not; and when the conspicuous difference in the thoroughness of the initial preparation is taken into account, the great superiority of German higher technical education becomes apparent.

10. *Significance of Higher Instruction in Mining for Germany.*—This is perhaps best disclosed by the number of students passing through the mining schools, and the output of the various mines.

The student numbers for 1901 are the following, viz.:—

	Germans.	Foreigners.	Totals
Berlin	239	20	259
Clausthal	185	37	222
Freiberg	186	280	466

The diplomas granted are small as compared with the total number of students. Thus, for Freiberg, in 1900, there were for mining engineering, 18; mine surveying, 12; metallurgical engineering, 3; iron metallurgy, 7; for Clausthal, 21 for mining engineering; for metallurgical engineering, 2.

The following production statistics are given for 1901:—

Mining Production in Germany.

	Works.	Workmen.	Value. £
Potassium Salts	59	13,192	2,171,000
Rock Salt	29	1,264	226,000
Black Coal	336	448,000	50,762,000
Brown Coal	562	58,537	5,514,000
Iron Ore	623	40,802	3,599,000
Zinc Ore	91	14,636	1,075,000
Lead Ore	200	13,701	707,000
Copper Ore	111	15,852	1,214,000
Silver and Gold	13	2,887	77,000

The totals for 1901 are from mining industry, £68,400,000; from metallurgical, £35,441,000, say, 104 millions sterling per annum. It

[1] Denotes that the course is for the Summer Semester only. [2] Denotes that the course is for the Winter Semester only.

It may be mentioned that the progress of Germany in mining and metallurgical industry is due to the extension of the railways; the great industrial advance since the Franco-German War; the demand for ores and salts for agricultural, technical and chemical purposes; the improved facilities for and methods of technical instruction.

11. *Special Features in the German Curricula.*—There are certain features of the curricula to which special attention may be given, because of their educational significance. One is the introduction of a course on *National and State Economics.* The syllabus runs somewhat on the following lines, viz.:—

Fundamental conceptions. Necessities of life. Goods value. Intercourse. Wealth. Economics. National economy.

Production. Nature. Work and capital as factors in production. Productive co-operation.

Circulation of goods. Commerce, traffic, commercial policy. Money, credit, and price.

Distribution of goods. Income, wages, interest, contracting profits. Ground rent. National income.

Consumption. Manner of consumption. Economical and extravagant luxury. Equilibrium between production and consumption. Economic institutions. Insurance.

Development of national economy. Antiquity and middle ages. Mercantile system. Physiocratic system. Adam Smith. Freetrade and protection. Communism, socialism, and anarchism. Social reform.

Financial science. State expenditure. Productivity of same. State revenues. Private revenues. Fees and taxes. State economy. State credit and debt. Voluntary and forced loans. Amortisation. Organs of financial administration.

The comprehensive view such as is calculated to be generated by the above course, acquires point from the treatment of, say, mining and metallurgical statistics. This last is developed as follows:—

Definition and aims of statistical science, Methods of investigation, Aids thereto. Importance of statistics for economy and practice. Statistics of the mines, metallurgical, and salt works of the various countries, having special reference to any variations, and their causes. Statistics of import, export, consumption, and prices in mining and metallurgical industries. Wages and workmen.

Such courses as the above, given as they are by highly competent instructors, are of great value in conferring political and economic outlook, and in enabling the technically-trained man to look upon technical and professional matters from the standpoint of a publicist, or at least that of a cultured and broad-minded citizen.

12. *Other Forms of Higher Technical Education in Germany.* The splendid courses in technical chemistry have already been referred to. [*See also* Chap. XXXI, secs. 12–13, pp. 313–4, for example.] The curriculum runs as follows:—

First Year.—Differential and integral calculus and analytical geometry; mechanics; descriptive geometry, with exercises; experimental physics; experimental chemistry, metalloids and metals; crystallography and mineralogy; "*Praktikum*" for crystallographical mineralogy; mechanical technology; machines, with exercise in machine drawing; general and special botany; microscopy; exercises in the physical laboratory, viz., physical measurements; practical work in the inorganic laboratory.

Second Year.—Organic chemistry; chemical technology; analytical chemistry; organic chemistry; theory of building construction, with exercises; spectrum analysis; practical work in the inorganic laboratory; metallurgy.

Third Year.—Agricultural industry; chemical technology; glass, ceramics, and apparatus connected with their manufacture; general geology; geological "*Praktikum*"; microscopic-crystallographical exercises; chemistry of foodstuffs; history of chemistry; general photography; introduction to photographic optics; photo-chemistry and photo-mechanical processes; photographical exercises in ordinary processes; practical work in the photo-chemical laboratory, specially for such students who desire to devote themselves to photo-chemistry; types of construction of photographic optical instruments; *colloquium* on subjects from organic chemistry; organic chemistry; practical work in the organic laboratory; microscopy.

Fourth Year.—Practical work in the technico-chemical laboratory; dyes, bleaching, dyeing, printing on materials, etc.; investigation of sugars; precautions against accidents, technical industrial hygiene; social, political, chemical and physiological industrial hygiene; sketch of the technique of gas analysis; practical work in the electro-chemical laboratory; general electro-chemistry; applied electro-chemistry; physical chemistry; thermo-chemistry; physico-chemical exercises; examination of vegetable and animal fats, oils and wax; examination of mineral oils and other naphtha products; exercises in heliographical work; "*Colloquium*" on subjects from organic chemistry.

The curriculum in Metallurgical Engineering, equally perfect, is as follows:—

First Year.—Differential and integral calculus and analytical geometry; mechanics; descriptive geometry with exercises; experimental physics; exercises in the physical laboratory; experimental chemistry, metalloids and metals; crystallography and mineralogy; crystallographical-mineralogical "*Praktikum*"; mechanical technology; introduction to engineering; practical work in the inorganic laboratory.

Second

Second Year.—Organic chemistry; chemical technology; analytical chemistry; spectrum analysis; practical work in the inorganic laboratory; general geology; geological "*Praktikum*"; metallurgy; preparatory operations; general docimacy; theory of building construction with exercises; mechanical technology; machines, with exercises in machine-drawing; mechanics of heat; encyclopædic electro-technics.

Third Year.—Chemical technology; glass, ceramics, etc.; microscopic-crystallographical exercises; general docimacy; machines, with exercises in mechanical drawing; practical work in the inorganic laboratory; elements of ordinary and underground engineering, with estimation of cost; arrangement and management of a foundry; practical work in the metallurgical laboratory; history of chemistry; lifting machinery (winches, cranes, etc.); exercises in the mechanical laboratory; theory of materials, with exercises in the mechanico-technical experimental station; theory of electrical measurements.

Fourth Year.—Practical work in the metallurgical laboratory; sketch of the technique of gas analysis; general electro-chemistry; applied electro-chemistry; exercises in heliographic processes; prevention of accident, technical industrial hygiene; industrial hygiene, social, political, chemical and physiological part; physical chemistry; thermo-chemistry; physico-chemical exercises; machinery, pumps, blast-engines; exercises in the electro-technical laboratory; exercises in the mechanical laboratory; construction and management of factories; plans of buildings, etc., for industrial mechanical contrivances.

With such teaching power as is implied in the indicated courses, it is not remarkable that unprejudiced judges proclaim the wonderful excellence of German technical instruction, and are anxious that the educational institutions of their own countries should reflect the same excellence.

Although not perhaps of immediate concern, it may be mentioned that Germany is preparing for an enormous development of oversea trade by equipping a large number of higher and secondary schools of *Naval Architecture and Engineering*.

The teaching of these subjects is organised at *Berlin* very thoroughly [Chap. XXXI, sec. 11, p. 313]. At *Danzig*, where the annual State aid will be £18,500, they will be treated as at Berlin. At *Hannover* and at *Braunschweig* lectures on the subject are given in connection with the departments of mechanical engineering; at *Aachen*, *Dresden*, *Karlsruhe*, *München* and *Stuttgart* naval machinery is discussed in the lectures in the departments of mechanical engineering.

There are also several secondary grade schools for ship building and naval engineering, but these are practically on a par with our highest grade of instruction.

These are the *Technikum* at Bremen, and that at *Hamburg*, both of which have a higher ship-building school, and a school of marine engine construction [*see* Chap. VIII, secs. 13–15, pp. 74–5]; and the Higher Engineering School at *Kiel*, which has departments of the same character.

The departments of Naval architecture deal with the following subjects, viz.:—

Mechanics of heat; elementary metallurgy of iron, including matters relating to armour plates, etc.; general theory of ships; plans of ships; practical shipbuilding; arrangement and construction of warships, which is very thorough, and deals with armoured decks above and below water, splintered decks, armoured bell, shields, gratings, supports for turrets and gun mountings, armour plating, resistance to shot, testing, etc., and a multitude of similar matters; marine boiler and engine construction; mechanical technology; electro-mechanics; and other less technical matters.

The creation of a great material testing station, the *Versuchsanstalt* of Grosslichterfelde, and the multiplication of schools for instruction in naval architecture and engineering, is consistent with Pan-Germanic enterprises, and meaningless without.

12. *Conclusions regarding German Higher Technical Education.*—The German methods of higher technical education seem to fall short of an ideal scheme by but a small distance. Insisting on good preparation in their excellent secondary schools, the student is started with a fine all-round culture. The career in the technical high school is not disturbed by the necessity for cramming for examinations; the student can aim at thoroughness without fear. The critical feature of the German method is the insistence on thorough preparation in secondary schools, with good teaching; the creation of technical schools, lavishly equipped, liberally staffed with teachers who are each specialists in the subjects on which they lecture, and who have made important contributions to knowledge. Good teaching, and practical work in an academic atmosphere, instinct with appreciation of original work, and with respect, not for the passing of examinations, but for the power to make new discoveries, and thus to add to human knowledge: these are the secret of the astonishing advance of Germany technically, industrially, and commercially.

XXI.

COMPARISON OF DIFFERENT SYSTEMS OF HIGHER TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Review of Higher Technical Education in Europe generally.*—A comprehensive survey of the organisation of higher technical education throughout Europe, discloses the fact that, on the whole, it is very similar; Russia, France, and perhaps also Italy, following less closely the German model than most other continental countries. Widely divergent as are the national characteristics of the peoples of Europe, their educational systems nevertheless shew a consensus of opinion that human nature is, from the educational point of view, a sufficiently constant quantity to make it safe to follow the main elements of any good model; and thus they freely study the systems of one another's countries.[1]

The equipments of the higher technical schools shew everywhere much the same developments, for these depend upon and respond to recent advances in physics and chemistry, and their industrial applications, viz.: in electro-technology, in chemico-technology, and in general industry.

Thus in *Italy*, the most striking feature of the equipment of the "*Regio Museo Industriale Italiano*" is the electrical, for instruction in the various branches of electro-technical science and electro-chemistry, etc. [Chap. XXXIV., secs. 7–13, pp. 359, 360.] This is the direct consequence of the ever-increasing significance of the part which electricity is playing in meeting human industrial and general needs. In *Switzerland*, the magnificent mechanical laboratory, recently equipped, discloses the importance of recent mechanical, hydraulic, and electrical developments. One sees the same in *Sweden*, and in *Holland*.

That most of the laboratories and technological equipments of the higher technical schools had had recent and liberal additions, was everywhere very obvious, and there is evidently a wide-spread, as well as vivid recognition of the great importance of higher, as well as lower technical education.

Among the striking additions may be mentioned colossal hydraulic laboratories, the introduction of steam turbines, the driving of machinery by application of electric motors, etc.

2. *Organised Higher Technical Courses in various European Countries.*—Excepting agriculture, higher technical instruction is given in *Austria* in the *Technische Hochschulen*, and the mining academies (*Berg-Akademien*). The departments of the former are usually the following, viz.:—

(i) Civil Engineering; (ii) Architecture, or Architectural Engineering; (iii) Mechanical Engineering; (iv) Chemical Technology or Technical Chemistry; (v) Special Subjects.

In the mining academies, as, for example, that of Pribram in *Bohemia*, there is, ordinarily, at least, (i) a general division; (ii) a school of mining; and (iii) one for metallurgy. [Chap. XXXIV, sec. 2, pp. 356–7.] In

[1] The absence of proper educational organisation in the United Kingdom is of course without real defences; nevertheless there are persons who affect to see advantages in its very inefficiency. As soon as education is treated seriously, as soon as its significance as a factor in national strength and safety is recognised, it must become systematic, and then the meaning of Matthew Arnold's admiration will be apparent.

In the technical high schools and institutes the courses are various, as the examples hereunder will sufficiently show.

In the *Finland* Polytechnical Institute (*Suomen Polyteknillinen Opisto*) the courses are :—

(i) Architecture ; (ii) Engineering ; (iii) Mechanical Engineering ; (iv) Chemical Technology ; (v) Surveying.

In *Holland* the Polytechnic School of Delft (*Polytechnische School te Delft*) has five courses, viz. :—

(i) Civil Engineering ; (ii) Architecture ; (iii) Naval Architecture ; (iv) Mechanical Engineering ; (v) Mining Engineering.

The Higher Technical Institute (*Istituto tecnico superiore*), and also the School of Application for Engineers (*Scuola d'applicazione per gl'ingegneri*) of Italy are generally annexed to the universities, and have a civil engineering section, one for architects, one for industrial engineers, and sections for the various teachers of science in the technical institutes.

In *Russia*, higher technical education is very variously organised. In the Higher Technological Institute of Nicholas I, there are courses which for two years and part of the third are alike for all students. The balance of the third and the fourth years are different, according as the students take up mechanical or chemical technology. [Chap. XXXIV, secs. 18, 19, pp. 361–2.]

The Electro-technical Institute of Alexander III has very complete courses lasting five years [sec. 20, pp. 362–3]. The variety of the higher technical schools will be apparent from the list in the Report [sec. 16, p. 361].

The libraries and laboratory equipments are very liberal; for example—in the Higher Technological Institute of Nicholas I there are over 35,000 volumes in the library, and extensive laboratory and technological equipment [p. 362]. The annual expenditure amounts to about £28,000, and the bursaries to £3,600.

At Stockholm, in *Sweden*, there are four-year courses in the Royal Technical High School (*Kongl. Tekniska Högskolan*), for mechanical engineers and technologists, naval architects, mining engineers, mining and metallurgical engineers, practical miners, architects, hydraulic engineers ; and three-year courses for chemical technologists, mining and metallurgical engineers. [Chap. XXXIV, secs. 22–36, pp. 364–372.]

A very excellent feature for architects is that three years may be spent in the Technical High School of Stockholm, and one year in the Academy of Fine Arts. The collection of architectural plans and photographs in this academy is a magnificent feature.

At the Chalmers' Polytechnic of Gothenburg (*Chalmers Tekniska Läroanstalt i Göteborg*) there are three-year courses in the higher, and two-year courses in the lower division.

At the Federal Polytechnical School (*Eidgenössische Polytechnische Schule*), at Zurich, in *Switzerland*, there are courses in architecture, civil engineering, mechanical technology, chemical technology, each of 3½ years duration. The pharmacy section is 2 years. Besides these there are excellent courses for special teachers in mathematical and natural science subjects. [Chap. XXXII, secs. 1–14, pp. 339–355.]

Throughout Europe, a high degree of preparation is demanded, so that the education received in these higher technical institutions is on a far higher academical level than in the University of this State.

3. *Higher Technical Courses in the United States.*—The opportunities for higher technical education in the United States are very great. A list is given of them for 1893 [Chap. XXXV, sec. 2, pp. 373–4], shewing the subjects of instruction, and also one for 1902 [pp. 374–5]. In the former year, there were 52 institutions ; now there are 84. These may be analysed according to the number of courses of instruction given, which are as follows :—

Agriculture only, 2 ; civil engineering only, 18 ; mining only, 1 ; mechanical engineering only, 6 ; electrical engineering only, 2 ; civil and mechanical engineering only, 4 ; civil and electrical only, 5 ; agricultural and mechanical engineering only, 2. Most of the remaining colleges have three or more courses ; these include agriculture, and civil, mining, mechanical, and chemical engineering.

It

It may be pointed out that no less than 20 institutions have courses in chemical engineering.

As already mentioned, the courses are four-year courses almost throughout. They are, however, not academically on the level of the German courses of the same duration, because the secondary school system of America does not reach the educational level of that of Germany. The intellectual training before entering upon the American courses is of a distinctly lower grade than it is in Europe. Consequently, the higher institution is doing a large amount of work that is undertaken in a secondary school in Continental Europe.

As in Europe, so in America, courses are not crowded together, as in the scheme of our State. It is, for example, quite enough for a student to attempt to become a mechanical engineer, or an electrical engineer, in four years; he certainly cannot be both. The preliminary education of the American student is better than with us, but is not, as stated, anything like equal to that of the European student entering on his professional courses.

The adoption of a system which allows a considerable number of options or electives tends also to make the results of American higher technical education more satisfactory than in the United Kingdom or in this State.

Higher technical education in the United States is provided in a large number of Polytechnics, Polytechnic Institutes, in Institutes of Technology, and in Universities. In essential character, these do not greatly differ. In some cases, they are very like the "*Technikums*" or "*Polytechnikums*" of Germany, and the "*Technikum*" of Winterthur, in Switzerland. The Institute of Technology in Boston is almost *sui generis*; and perhaps also the Stevens Institute of Hoboken; nevertheless, they are not very dissimilar in general organisation to the Technical High Schools of Germany, and, especially as regards their most advanced planes of work, have much the same general ideals.

An exhaustive comparison is outside the scope of this summary. The variations in the form and character of higher technical education *within* the United States can best be understood by comparing the work done in the institutions, mostly polytechnics, referred to in Chapter XXXV, with that referred to in Chapters XXXVI and XXXVII discussing the two Institutes of Technology, and also that referred to in Chapter XXXVIII, discussing the higher technical courses in the Universities.

The programme outlined in these several chapters are those in the following Institutions, viz.:—

(i) Washington University, St. Louis; (ii) The Brooklyn, (iii) Worcester, (iv) Rose and (v) Rensselaer Polytechnics, situated at Brooklyn, New York; Worcester, Massachusetts; Terre Haute, Indiana; and Troy, New York; (vi) The Massachusetts and (vii) Stevens Institutes of Technology; (viii) The Lawrence Scientific School, Harvard University; (ix) The various colleges in the California University at Berkeley, San Francisco; (x) The Cornell University, Ithaca, New York; (xi) The Sheffield Scientific School, Yale University, Newhaven; (xii) The Towne Scientific School, Pennsylvania University, Philadelphia.

A study of the technical curricula of these gives a sufficiently varied account of technical educational organisations in America.

The difference between the American and European systems is that the technical high schools of America are largely schools *within* Universities. Owing to this they cannot be so perfectly developed from the technological point of view as the technical high schools of Europe, which are *special* schools.

Reference has already been made in this summary [XIX, § 10] to the lavish equipments of the American scientific schools. These are sometimes on an almost colossal scale. At Michigan University, for example, at the time of the Commissioner's visit, an enormous basin was being constructed for experiments to determine the laws of resistance to the motion of ships. At Cornell the hydraulic laboratory is quite unique[1].

These

[1] It may be also mentioned that at Darmstadt, in Germany, there was very extensive laboratory apparatus to determine the erosion effects of water flowing in channels; and at Zurich, Switzerland, to determine the resistances of water to flow.

These large and well-equipped special laboratories allow certain types of research to be executed, *but do not require to be duplicated* in other Universities or Technical Institutes in the near vicinity. One could not carry out hydraulic experiments so well, say, at Berkley University as at Cornell, simply because the equipments are necessarily different; or, test materials on a large scale as well, say, at Karlsruhe as at the great *Versuchsanstalt*[1] (Experimental Institution) at Grosslichterfelde, near Berlin.

4. *Higher Technical Education in the United Kingdom.*—That the need of better technical education is coming to be appreciated in the United Kingdom is reflected in the progressive expenditure of the London County Council thereupon. For the years ending 1894 to 1904, this expenditure, in thousands of pounds sterling, was :—

1894 ...	4·5	1897 ...	116	1900 ...	145	1903 ...	236
1895 ...	42	1898 ...	118	1901 ...	208	1904 ...	305
1896 ...	77	1899	129	1902 ...	173	1905 ...	?

But the sum of £305,213 for 1903-4 is not large in view of what is needed.

Higher Technical Education is provided in the Universities of the United Kingdom. The report contains an account of the curricula in the Universities of Birmingham, Liverpool, Manchester (Victoria University), the Yorkshire College of Leeds, the Durham College of Science, King's College, London, the University of Edinburgh, the Heriot-Watt College of Edinburgh, the University of Glasgow, the Royal University of Ireland, the University Colleges of North Wales, Bangor, and South Wales and Monmouthshire, Cardiff.

The Manchester Municipal School of Technology is an excellently equipped institution, giving instruction of a grade comparable to that of the Universities.

The courses offered shew considerable variety, and there are a large number of options; these mark a forward step in English education. There is no academic freedom, however, in any way corresponding to that of Germany.

A feature of interest is an arrangement between the Heriot-Watt College and the University, both of Edinburgh, *viz.*, that part of the study and practical laboratory work for the degrees in Engineering in the University may be had in the College [Chap. XXXIX., sec. 20, pp. 472-3]. The relation between the two is similar to that between the University and Technical College in this State, with the exception, however, that the University of Edinburgh is very poorly equipped for the teaching of Engineering, and the necessary practical exercises cannot be organised therein.

5. *Anglo-Saxon Tendencies in Higher Technical Education.* The reactions of the higher education of America and Europe on England are remarkable. In filling her professorial chairs, America has been much more free from insular views than most countries; a fact due no doubt to the cosmopolitan character of her population. Her professors visit Europe very frequently, and in this way keep in very close touch with every advance in Europe. Many of her professors are excellent linguists, and a great many speak French and German with, at least, moderate facility.

Although so close to Europe, this is less true of the United Kingdom; and the powerful influence of Oxford and Cambridge has, perhaps, strongly accentuated what may properly be called the insular attitude to the question of education generally.

Professors of scientific subjects, scientific observers, and men of truly liberal education have, however, clearly recognised that the general educational and technological progress of continental Europe is such that no one can afford to be ignorant thereof: large numbers of the more earnest have acquired a speaking knowledge of several European languages so as to be able to come into closer relations

[1] This magnificent institution is a presage of further technical and industrial advance in Germany. It is a colossal institution, and has no meaning unless Germany intends that her future progress shall be at a rate and on a scale which will quite overshadow her past brilliant achievement. The whole development of Germany is a *fruit of education*, and her anticipations for the future are that it will witness a still more magnificent success. It has changed Germany from an agricultural to an industrial country.

relations of personal and scientific *camaraderie*.[1] This spirit has been reciprocal, and happily has issued in a more friendly spirit and a better appreciation of one another's educational and other ideals.

The consequences were inevitable. These circumstances have brought about a distinct tendency in University development in the United Kingdom which can be easily perceived. The organisation of the Birmingham University, for example, decided upon after a special review of the trend of modern European education, reflects this. It led to a recognition of the fact that the maintenance of the type of University represented by the Oxford or Cambridge of a few years' back, would be to place the British student under very great disabilities. The whole modern University movement may be described on the one hand as an enlargement of British academic conceptions of what may be properly regarded as constituting culture, and on the other an endeavour to bring a larger section of the community into touch with the highest planes of education. This involved several things, viz.:—

(1) A complete change of attitude in regard to scientific knowledge generally.
(2) A far-reaching change of view as to the value of modern languages as instruments of culture, which may well take the place of ancient languages.
(3) A recognition of the fact that not only science but even technology was worthy of inclusion within the purview of higher education.
(4) A complete abandonment of the view that Latin and Greek, or either of these languages, was an essential in liberal education.[2]
(5) A recognition of the fact that persons possessing even a fine knowledge of only ancient languages, but none of science or technology, are really only half-educated, and that, so far as education is concerned, such persons do not possess a normal mental horizon, and a normal understanding of the conditions of modern civilisation.
(6) A perception of the fact that the older traditions as to the possible range of careers for the liberally educated are arbitrary, illiberal, and injurious.

The changes which are taking place in English higher education as a consequence are momentous, and give promise of its reaching a more satisfactory level, not only in higher technical, but also in general education. The modern trend of English education is in response to this change of view, and the injurious effect of the older education upon British industrial and commercial power is being minimised. The education of to-day is coming into closer touch with the national life and its necessities, and there is a rapidly growing appreciation of the dignity of branches of knowledge hitherto despised by those ignorant thereof.

The transforming of the point of view as to what constitutes liberal education, is not only changing the whole tincture of the modern British university, it is also clearly tending toward the acceptance of the principle of freedom of choice as to university studies. Still more important is the fact that the less conservative secondary schools are being equipped with laboratories, and apparatus, and with more accomplished teachers. In short, we are steadily learning educational method from continental Europe.

6. *Original research in Science and Technology, and its Relation to Technical Efficiency.*—The attitude of a people towards original scientific investigation profoundly affects the industrial efficiency of its units. All scientific investigation is *non-utilitarian*, but the knowledge that comes in this way is often of very great utility in industrial advance. It has been estimated that the practical value to France of the researches of M. Berthelot is greater than the whole cost of the Franco-German War, with the indemnity included. The fates of industries often depend upon scientific discovery, as the work of Pasteur in regard to diseases of the silk-worm so well shewed. The development of the beet-sugar industry, and of the aniline, alizarine, and dye industries generally, also confirm the statement.

The appreciation of this fact in Continental Europe has led to a state of things which is very remarkable and worthy of special mention. Proprietors of large industries employ scientifically trained men to investigate, not merely scientific matter

[1] At the informal part of the meetings of the Royal Society of England, one often hears many a conversation proceeding in French and also in German and Italian. Occasionally even primary school teachers visit Europe for general and linguistic studies.

[2] It is well that *some* should thoroughly learn these languages. On their own initiative many will learn them when they are well taught. It is remarkable that where these languages are much better learnt than they are in the United Kingdom, the insistence upon their being universal has been abandoned. This has been discussed in the earlier reports.

matter in direct connection with their industry, but generally. Men who make discoveries are retained in employment, even when those discoveries have no immediate bearing on the industry in question; so vividly is the fact of the interdependence of various items and branches of scientific knowledge appreciated!

In 1901 there were about 4,500 technical chemists employed in various German works, and Germany had trained about 7,250 chemical *specialists* of various kinds. As far back as 1897, not less than 67 works employed 1 chemist each, 33 works from 6 to 20 chemists, 9 dye works from 20 to 105 chemists.[1] The conditions under which these chemists labour depends almost wholly on the attitude of the employer to scientific research. A narrow man would regard much of their work as having practically no bearing upon his business; and it is exactly there, where a broader scientific tradition plays its important rôle. The better educated man, and man of larger scientific and industrial horizon is capable of recognising that the ultimate value of a discovery may be of immense importance, notwithstanding that its direct value may be negligible or zero, and it is because of this that German industry thrives so well. Our own industries are hampered because we have not a like spirit.

This attitude of mind is developed in the Universities and Technical High Schools, and to a lesser extent also in the Secondary Schools. Many of the professors and teachers of the Secondary Schools have themselves made important and even splendid contributions to science.[2] This fact gives a tincture, not only to the German teacher, but to the mind of the whole nation.

Everywhere in the world, the so-called "practical man" has held systematic and scientific training in derision. He has loudly declaimed against scientific "faddism" as valueless. But Germanic and Japanese developments are a reply to this nationally injurious attitude. Germany has changed nationally from a life, very largely agricultural and weak industrially, to one much more scientific and profitable in agriculture, and at the same time one of enormous industrial power. This she has done by the reactions of higher education upon lower, and by the development of a national and broad scientific instinct. One hundred years has been taken in this development. Japan has profited by this lesson, and in one-third or fourth of the time has created the same intense appreciation of what scientific spirit can do for a nation.

English experts point out that we must nationally change our attitude or submit to national decay, and English educationists are trying to bring about such a change. No one in Germany would now argue the "practical man's" view. The case has gone by the board.

The instinct of appreciation of science is easily developed by science teaching, and still more by participation in some form of original research.

The academically bracing atmosphere of the German University has been referred to in eulogistic terms by our own countrymen, who have spent any time therein, and who really know something of what they are speaking.

Our University and Technical Educational system is being influenced in the right direction, but not sufficiently. Students and members of the teaching staff, without exception, should have larger opportunity for undertaking original scientific work. This, however, is hampered in two ways, viz., by:—

(1.) Insufficient preparatory education of the student, and consequent absence of maturity in the scientific element of his mind.

(2.) The notion, which occasionally manifests itself, that professors in charge of departments are entitled to be invariably associated as joint authors with the work done in the laboratories under their charge,[3] or even to wholly appropriate, practically, the whole of the work done by their juniors or colleagues.[4]

The

---

[1] Not persons who have an amateur knowledge of, or a mere smattering of chemistry; but highly trained chemical specialists.

[2] That anyone should be able to retain the directorship or headmastership of an important secondary school without making eminent contributions to some branch of human knowledge, such as mental or natural philosophy, or pædagogy, etc., is probaby unexampled in Continental Europe.

[3] This immoral attitude is not wholly unknown in official circles, where credit has been wrongly appropriated by higher officers. This occurs wherever these hold their posts not through merit, but for some other reason; they are almost forced to attempt to exploit the higher attainments of subordinates, and to endeavour to retain a reputation to which they have no claim. To this is due the very serious mistakes which are discovered, or become obvious, and many others which, though equally serious, are never publicly revealed.

[4] There are cases where the professor simply directs work to be done, and regards it as his own.

The only reward which the scientific worker has for his sacrifices of time, opportunity, and money, is the *kudos* attached to the work done. Under an academically honest policy the real worker is never robbed of this, and it is nationally important that he should not be, for, on account of his merit, his advancement is in the public interest. This helps the community to defend itself against pretenders, and to place itself under the lead of men of genuine and thorough attainments.

Here, again, the atmosphere of a German University is excellent. Its traditions in this respect are uniformly honourable, and give students every encouragement to undertake original research, as their doctorate theses abundantly testify. It is not the examinations a student passes, but his original contributions to knowledge which win for him distinction and advancement.

The psychological value of original research is obvious. It is *creative* effort, and cultivates power of initiative, and of applying known principles as guides in unknown fields. Industrial enterprises depend for their success upon this very spirit, and hence the training of the Germany University and Technical High School is in the front rank of helpful education.

What has been said in these respects applies, *mutatis mutandis,* to the other higher education and technical institutions of Continental Europe. Up to the present, America has caught more of this spirit than has the United Kingdom.[1]

British methods are not wholly free from the exploitation of other minds, with but partial acknowledgment, or even its complete absence. This element is changing, and as time goes on the advanced student is getting increasing opportunities of original work under normal conditions.

7. *Concluding Remarks.*—To have made an exhaustive comparison of Higher Technical Education in various countries would have exceeded the limits of this summary. Enough has been adduced to give a general idea of characteristic differences.

To sum up, the Continental ideal is :—

(1.) To found higher technical (or other) education on the basis of an excellent secondary school preparation of a definite and thorough character.

(2.) To create in this way a condition which makes possible an academic freedom, such as will allow for greater individuality of development.

(3.) To give thorough courses of limited range, and of sufficient duration to reach real efficiency.

(4.) To create a profound respect for original effort in investigation and research as an instrument of culture.

America is following in much the same direction, but her courses are less thorough than, say, the German. The United Kingdom can only reach the same level by thoroughly organising, at least, higher Secondary Education; it cannot reach it as long as it fails to do this.

[1] Changes are taking place, but they are greatly hampered, among other things, by our passion for examinations.

XXII.

CONCLUSIONS AND RECOMMENDATIONS REGARDING HIGHER TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. The importance of higher technical education.
2. General conclusions.
3. Objections anticipated.
4. Is reform possible?
5. Recommendations.

1. *The Importance of Higher Technical Education.*—" Is higher technical education of any importance ? " may well be asked. The following facts regarding *mining* will give some indication of the answer for one branch. The value of the plant and machinery used in mining, the number of persons employed, and the value of the output, according to the 1903 " Statistical Register," is as follows :—

Mining.

	Plant and Machinery.	Persons Employed.	Value of Output.	
	£			£
Metalliferous mines	2,097,710	23,442	Copper	446,286
			Tin	155,723
			Silver and lead...	1,501,403
			Gold	1,080,029
			Other metal, etc.	300,747
Coal-mining	1,770,312	14,177	Coal	2,319,660
			Coke	108,764
Totals	£3,868,022	37,619		£5,912,612

The total number employed in manufactories and works will also give some indication of the magnitude of the interests with which technology is concerned.

Manufactories and Works.

Plant and Machinery.	Persons Employed.	Horse-power used.	Wages Paid.
£7,009,806	65,633	59,353	£4,839,557[1]

The total of the mining and manufacturing interests is obviously considerable. The measure of the importance, however, is not merely the magnitude of existing interests, but of those which are likely to arise in virtue of the raising of the general level of intelligence and technical efficiency. It is exactly that which the history of the German Empire has taught, viz., that the statesman who is to advance his country must not wait for wants to arise, but anticipate them ; and of all expenditures which promise abundant return, education may be placed in the front rank. The whole movement of German education has been in advance of existing requirements.

2.

[1] About two-thirds of this is paid in the metropolis, one-third in country districts.

2. *General Conclusions.*—The drift and purport of the concluding remarks of the preceding division may be restated in another form. A wide review of higher technical education, and a comparison between the methods of this State with those of Continental Europe, or even with those of America, disclose four things, viz.:—

i. That the organisation of higher technical education in this State, and methods of instruction therein, cannot be compared in thoroughness with those of Continental Europe.

ii. That while it retains its characteristic features the existing scheme can never achieve such thoroughness as to make it a peer among the Continental systems of higher technical education.

iii. That the variety and range of technical education here is not only very limited; it does not meet existing requirements, and certainly does not anticipate future devolopments.

iv. That a sound advance depends fundamentally upon the general improvement of secondary education, by which means alone adequate preparation for courses in technical subjects and in higher technology generally can be assured.

Now, if such conclusions are justified by the facts, the measure of the seriousness of the situation presents itself at once for consideration. This is determined by the answer which must be given to the question "Is technical education a factor of moment in national strength and solidarity, and in meeting the commercial and industrial rivalry of other peoples?" To this comes the answer of Prussia's defeat in 1806, France's defeat in 1870, and Russia's defeat this year. In the former cases it has been openly admitted by the defeated party that national power depended largely upon educational superiority; that the defeat was due to educational neglect. In the last case, Japan's wonderful educational advance goes far to explain the unprecedented thoroughness of her movements.

3. *Objections Anticipated.*—It is important that some objections should be anticipated.

Against conclusion (i), national indifference and vanity are likely to provoke resentment. To this it may be replied that no one can impartially study the facts and fail to reach the conclusion. Our own countrymen are warning us in language, the import of which is as serious as public and responsible utterances can possibly be [Chap. IV, secs. 1-7, pp. 15-24]. Every competent observer who has witnessed the facts, and who has made a thorough study of the question, draws the same conclusion.

Regarding conclusion (ii), it is customary to hear the shallow criticism urged that the genius of English education is opposed to stereotyped methods. The truth is—and it is a truth, the pungency of which lies in its verity—that, as a nation, we are the victims of a very large amount of *educational quackery*, which is menacing our national status; and this quackery shelters itself under pretentions to genius. The implication of want of flexibility in the methods of other nations is untrue.[1] Further, it may be said that there is undoubtedly a science of education, and educational organisation should conform thereto. Indifferent organisation is not the mark of excellence, or of some extraordinary genius which makes our nation independent of the universal laws governing the evolution of the human body and mind; it is simply the mark of that national indifference to good education which has been satirised by Dickens and Thackeray.

It is unquestionable that the results which can be, and are, achieved by establishing a good system of thorough secondary education, as a preparation for higher education, are vastly superior to those which are reached with an inferior and irregular secondary system. The

[1] The boast that the French Minister of Public Instruction could tell what passage was being read in every school in France must be taken *cum grano salis*. As a matter of fact, the French trained teacher is much more free than the teacher of our Department of Public Instruction, just because he is trained.

The statement in the report of 15th July, 1902, of the special sub-committee of the London County Council's Technical Education Board, that we must change our educational indifference, *or must submit to national decay* [Chap. IV, sec. 2, p. 16], is believed by the Commissioner here writing to in no way overstate the serious nature of the situation[1]; and if this judgment be correct, our worst enemies are those within our own borders who try to prevent us realising the truth as to the grave consequences which, sooner or later, must overtake us because of our educational demerits.[2]

To conclusion (iii), it will be answered that there is no existing demand for technically well-educated men. This can be answered among other ways by analogy to individual experiences. The youth who succeeds is not one who waits for posts to be offered before he prepares himself for them, but one who anticipates the situation, and is found to be ready when the opportunity occurs.

Where any form of higher practical education[3] has been received, the student is benefited, even though he may be unable to immediately devote his talents in the way desired, and no form of higher technical education unfits for humbler occupation. On the contrary, it gives great resource.

The experience of Germany, America[4], and Japan, has shewn that the advantage lies with the nation that *anticipates* the requirements of its people; not the nation that waits till the need has become urgent.

So long as the technical branches of University education in this State remain at their present level, it will be impossible for Australians to command the best posts: they are likely to fall to men of better education and training, or possibly to Englishmen of much the same education as ourselves, but whose limitations have been disregarded.

If this State normally developes, we shall require chemical, electrical, mechanical, agricultural, and other experts, and a much better-educated class of technical instructors.

The last objection which may be anticipated, viz., to (iv), scarcely needs answer. No one can examine a German secondary school, take stock of the calibre and training of its professional staff, look at its equipment, without recognising how much better prepared the German student is than the English student, or our own. There is no short cut or royal road to educational thoroughness available for us alone. The truth is, that our education is slovenly and indifferent, our educational traditions such that we tolerate these defects, in fact, are almost unconscious of them. It is only by study and personal visitation that one is able to appreciate how grave are those national limitations which our insularity tempts us to ignore.

4. *Is reform possible?*—A word may be said as to the *practicability of reform.* Those who are indifferent to good education, or whose *vis inertiæ* is such that they do not care for change, even though the national destiny demands it, are ever ready to declare that the better state of things is impracticable, notwithstanding its actual realisation elsewhere. Change for the better has never originated with this class, nor has such change come by popular demand, for a people is not vividly conscious only of the state of things to which custom has habituated it. Those who know our needs carry upon their shoulders the responsibility of endeavouring to bring about reform. It needs only earnestness to bring it about. It would surely be an un-British action to accept defeat in the world of educational ideals and methods, without

[1] The facts and opinions recited in Chap. IV, as to the gravity of our national position through defective education, are commended to the notice of those whose antagonism to reform arises from educational indifference, or from interested motives, or from insular vanity. Foreign nations know the truth about us.

[2] It is mentioned in the report referred to that America had recently—*i.e.*, in 1902—received £13,000,000 for her universities alone. That amount has, I believe, been exceeded since. Dr. Carl Peters points out how niggardly—"ridiculously small"—is English expenditure on technical education.

[3] From that type of English University education which creates in the student sentiments utterly inconsistent with the existing conditions of the world and its stern realities, and often leaves him stranded with an imperfect command of Greek and Latin, and no practical or useful knowledge or accomplishment, no inference should be drawn, except that it is not a normal scheme of education.

[4] The history of the Massachusetts Institute of Technology is instructive in this connection. See Chap. XXXV, secs. 1, 2, p. 400.

without even an effort to place the greatest of all our public institutions in the front rank of excellence, and make our educational organisation worthy of the present place of Britain in the world's economy.

The *only* hindrances are indifference and niggardliness as to expense.[1] (See footnote.)

5. *Recommendations.*—The following recommendations are all practicable if we are in earnest as to the much-needed reform of our educational system:—

1. That the higher technical courses in the University and in the Technical Colleges should be allowed only after suitable preparatory education.
2. That special preparatory schools be created, so that students should pass through such period of preliminary education as is requisite to enable them to attend the technical or professional courses of the University or Technical College. Thus, preparatory schools could be within the institutions referred to.
3. That the character of the courses in the University and Technical College be suitably raised and made much more thorough.
4. That the number of possible courses be increased so as to include as many as possible of the following, viz.:—
   (1) Architecture.
   (2) Chemical technology.
   (3) Electro-chemistry and chemical engineering.
   (4) Civil engineering.
   (5) Electrical engineering.
   (6) Mechanical engineering.
   (7) Hydraulic engineering.
   (8) Metallurgy.
   (9) Mining engineering.
   (10) Practical mining.
   (11) Pharmacy.
   (12) Surveying.
   (13) Higher surveying and geodesy.
   (14) Agriculture.[2]
   (15) Commerce.
5. That until the University of Sydney allows those who desire to enter for scientific and technical courses to matriculate *without Latin*, the highest branches of the scheme of technical education under the Technical Branch of Public Instruction be constituted as nearly as possible on the lines of the recent polytechnical schools of Europe, as a step towards the creation of a technical high school or University.
6. That when the University ceases to insist upon Latin for matriculation in scientific, engineering, and technological subjects generally, an endeavour be made to correlate the higher work in the Technical College with that of the University, that they will harmonise with and as far as possible supplement one another, somewhat in the manner for example of the Heriot-Watt College and University of Edinburgh [Chap. XXXIX, sec. 20, p. 472].
7. That, independently of any decision with regard to Latin, an endeavour be made to establish correlation between higher technical subjects, as taught in the University and in the Technical College (provided that this in no way hampers the development of the College if necessary as a Technical University), so as to afford students the fullest opportunity for any type of technical education they may desire.
8. That all courses be reorganised, so as to secure educational thoroughness, the necessary alterations in and additions to the teaching staff being made.

---

[1] That we are *niggardly* is shewn by the following figures, giving the cost per annum of the *primary* education of each pupil:—

	£	s.	d.		£	s.	d.
North Atlantic div. United States ...	6	18	8	United States (average)	4	9	1
Western do. do. ...	6	11	7	New Zealand	4	7	4
Argentine Republic	5	16	11	Bremen, Germany	3	16	6
Manitoba, Canada	5	12	1	Hamburg	3	13	7
British Columbia	5	2	7	New South Wales...	3	8	2

Such figures show that we do not yet believe in education, for in a sparsely populated country it is necessarily costly, and yet we do not pay as much per pupil as is paid in Bremen or Hamburg, with their dense populations!

[2] These are inserted, as they have been recommended before.

XXIII.

XXIII.

ART-INDUSTRY SCHOOLS.

[G. H. KNIBBS.]

1. *Origin and Character of the Art-Industry School.*—The London Exhibition of 1851 gave the first great modern impulse to systematic instruction in Art Industry, and England herself was the first to profit thereby in the creation of the Department of Science and Art and the South Kensington Museum. Soon afterwards the example of England was followed by Germany. The economic disasters which Napoleon had inflicted on her resulted in such exhaustion that for a number of years the demand for artistic products was very small, and in consequence the art element in her industry sadly needed rehabilitation. When she became acutely conscious of this, her educational instinct or genius prompted the creation of a large number of special schools, the object of which was to train for the production, not merely of technically perfect wares, but such as demanded artistic finish. These special schools are the Art-Industry Schools.

The first object after the Napoleonic wars was, naturally, to look to the services of the skilled "*Handwerker*" (artisan) or "*Techniker*" (technical workman) rather than to those of the "*Kunstfertige Handwerker*" or "*technische Künstler*" (artistically-skilled artisan or technical artist). But, as stated, the English Exhibition awakened a new, or rather a dormant, impulse to rehabilitate the artistic element, and when she seriously set about the necessary special education, Germany endeavoured to make them worthy of her other educational institutions, and has so far succeeded that this division will advisedly be largely devoted to a description of them.

2. *The Aim of Art-Industry Schools in Germany.*—To understand the exact nature of the Art-Industry School some reference is necessary to the types of existing school in which the art element is included. These are the following, viz.:—

German Name.	English Significance.	Remarks.
(1) Kunstchulen...	Art Schools	Schools for Art Training or Education.
(2) Kunstgewerbeschulen ...	Art-Industry Schools ...	Higher Grade[1] Schools for Education in Art as applied to Industries.
(3) Kunstgewerbe und Handwerkerschulen.	Art-Industry and Artisan Schools.	Lower Grade[2] Schools for Education of Artistic Workman.
(4) Kunstund Gewerkschulen ...	Art and Artisan Schools ...	Schools for the Education of Tradesmen or Artisans who need some Artistic Training.
(5) Gewerbliche Zeichen und Kunstgewerbeschulen.	Industrial Drawing and Art-Industry Schools.	Schools for Education in the application of Art to Industry, in which the Industrial Drawing is a very special feature.

All of these may be distinguished from the *Handwerkerschulen* or Artisan Schools, pure and simple. They are, however, not the only schools which in the artistic

[1] From the point of view of the Art Element.

artistic element appears. Many art-industries are represented in the schools for *special industries*—*i.e.*, schools solely devoted to education for particular industries, such for example as the textile, ceramic, wood-working and metal-working industries, and the building-trades. Even in the general artisan schools (*Gewerbeschulen*) there is often quite a considerable amount of art instruction.

The aim of the Art-Industry Schools may, therefore, be described as an endeavour to intensify the artistic sense in the higher class of workmen, so that they may embody this in the manufacture of ordinary practical objects of daily use. In this way goods will not merely be serviceable, durable, and well-designed, they will also exhibit grace of form and harmonious colouring.

3. *Remarkable Change of Attitude as to Artistic Style.*—A wide survey of all forms of art has developed a recognition of the fact that there is some subtle connection between the spirit of a nation and the material forms in which its artistic sense is expressed. Governed largely by tradition, it was the custom until quite recently to give unqualified prominence to the study of the antique and earlier styles. This, however, has given place to a cultivation of the individual student's own style, the study of the former being no longer intended to constitute canons of style from which he must in no wise deviate, but merely to broaden his art-horizon, and deepen his artistic consciousness. And it does this as much, or even more, by awakening his sense of individuality in artistic feeling, as by provoking the spirit of artistic imitation.

It is now recognised in the German Schools that the modern German can no more receive and reflect impressions, or create art-forms or colourings, corresponding to the Greek, Roman, or Gothic periods, than he can reflect the artistic sense of China or Japan, India, or Russia, or any other equally-characteristic country. Nor does strength lie in imitation, but in self-development, in evolving that which coincides with one's deepest artistic feeling.

Hence, although the study of the antique, etc., is not neglected, the study of local colouring, landscape, of plant life and animal life, and characteristics of the human form and its variation, is prosecuted. Students endeavour to find out and copy the most beautiful bits of scenery, and they are encouraged to create designs reflecting their own ideas as to style, etc.

4. *General method of developing artistic technique.*—After the usual lectures in the history of art, and instruction in geometrical drawing, ornamentation with design, descriptive geometry, the theory of light effects, perspective, profile and outline drawing, freehand drawing, figure drawing and anatomy, of plants and flowers, the study of style, painting in water-colour with colour studies, drawing from the nude, drawing and painting from nature, etc.—the special object of all of which is to secure faultless artistic representation—the students are exercised in the independent construction of models from their own designs, the object of this being to make the students *something more than mere draftsmen*. These exercises also enable the art-designer to grasp more clearly the question of the practicability of his art-designs. Models are made in gypsum, cardboard, etc., designs are worked out in clay, *plastilin* or plasticene, etc., and in ceramics pupils turn their vases on the potter's-wheel, glaze and fire them, paint their designs thereupon, etc.

It may be mentioned that not only did Germany profit by English example initially, but the directors of her art industry schools still closely observe British methods and equipments, and unhesitatingly adopt whatever they conceive to be excellent. The magnificent museum of South Kensington served as a model, and so also do the very high artistic quality of a large number of English products.[1] The defects of the German art-industry schools will be referred to later.

5.

[1] Especially textiles. A comparison of the German with English goods, will shew that the artistic advantage is often on our side.

5. *Rapid Multiplication of German Art Industry Schools.*—The rapidity with which the Art Industry Schools have been multiplied is worthy of remark. They appear in the following list in the order of founding, viz.:—

Art Industry Schools of Germany.

Town or City.	Founded.	Teaching Staff.	Remarks.
1. Nürnberg ...	1662	16	Private school; *Kunstschule* 1821, *Kunstgewerbeschule* 1833, reorganised 1878.
2. Königsberg P.	1790	18	Reorganised 1808, 1882, 1885.
3. Breslau ...	1791	22	First a *Kunstchule*; then combined with a Building School, 1801; reorganised as a *Kunst und Kunstgewerbeschule* in 1876.
4. Magdeburg ...	1793	51	*Kunstschule*; reorganised as *Kunst und Kunstgewerbeschule* in 1871; present organisation since 1887.
5. Mainz ...	1841	72	Originally a *Handwerkerschule*; in 1879 a public drawing hall (*Oeffener Zeichensaal*); reorganised 1884, 1888, 1903.
6. Berlin ...	1868	36	*Kunstgewerbeschule*, associated with the Art Industry Museum; reorganised 1876.
7. München ...	1868	28	Extended to include a Women's Department 1872.
8. Cassel ...	1869	15	Reorganised 1880, enlarged 1888, became State School 1903.
9. Stuttgart ...	1869	10	Originally attached to the Higher Technical School; independent thereof since 1880.
10. Dresden ...	1876	20	Reorganised that year; originally part of Polytechnic School.
11. Pforzheim ...	1877	10	*Kunstgewerbeschule* from founding.
12. Karlsruhe ...	1878	24	" " "
13. Frankfurt a/M	1879	17	" " "
14. Köln... ...	1879	16	" " "
15. Düsseldorf ...	1883	14	*Kunstgewerbeschule.*
16. Aachen ...	1886	42	Also a *Gewerbliche Zeichenschule.*
17. Dessau ...	1888	29	Also an Artisans' School.
18. Hannover ...	1890	60	" " "
19. Barmen ...	1894	27	" " "
20. Charlottenburg	1896	...	" " "
21. Elberfeld ...	1897	...	" " "
22. Erfurt ...	1898	14	" " "
23. Leipzig ..	1900	25	Founded by combining *Kunstakademie* and *Kunstgewerbeschule.*
24. Altona ...	1901	...	Reorganised the year mentioned.
25. Strassburg ...	1902	14	" " "
26. Crefeld ...	1903	...	Also an Artisan School.

Some of these schools spend up to £10,000 per year on art-industry education alone.

The schools seen by the Commissioners were finely organised. This rapid multiplication of artistic technical schools is characteristic also in the United Kingdom, and their value is better appreciated as time goes on, and as the importance of their work thus becomes increasingly manifested.

6. *General Organisation of the German Art-Industry School.*—In the German Art-Industry schools, the following grades of instruction are commonly provided, viz.:—

(i) Art-Industry School, proper, *i.e.*, a day school.	(i) Preparatory classes (*Vorklassen*). (ii) Series of classes for various trades or industries (*Fachklassen*).
(ii) Associated Evening School ...	(i) Continuation classes (*Fortbildungsklassen*) in general subjects. (ii) Special instruction in trades or industries.
(iii) Sunday Morning School[1]. ...	Usually for industrial drawing (*Gewerbliches Zeichen*).

The fully organised school is the first (i), but there is considerable variety of organisation, depending upon local conditions. On the other hand, the organised courses may be so developed as to embrace work in both the day and evening schools. The

[1]Touching the existence of a Sunday morning school, which is very widespread throughout Europe, it should be remembered that religious instruction for children is much more thorough during the week and in the ordinary schools, than it is in our Sunday Schools with such religious instruction as is given in the Public School combined. The only difference is, that the presence of the religious idea is less restricted to a single day of the week than with us.

The preparatory classes (*Vorklassen*) include the elementary branches, drawing from copies, from casts, drawing and painting various objects from the vegetable, animal, and mineral kingdoms, modelling ornaments and figures, projection, shading and shadows, anatomy, methods, the history of Art, etc.

The special-subject classes (*Fachklassen*) are for pupils who have had the necessary preliminary instruction.[1] They are sometimes divided into groups (*Abteilungen*) according to their association with particular forms of industry; for example:—Architectural classes, sculpture, painting, various minor arts, etc. An example from the Mainz school will afford the necessary illustration:—

Division I—

Preparatory for all students. Two classes each of half-year.

Division II—

Special for the following, *viz.*:—(i) Architecture,[2] *i.e.*, building construction and decoration; (ii) interior decoration, minor art, ornamentation, artistic door fittings, etc.; (iii) cabinet makers, carpenters, furniture designers, etc.; (iv) decorative painting; (v) modelling, chasing, etc.; (vi) ceramics; (vii) graphic art; (viii) wood-carving. All these classes are one semester (half-year) each. A full course consists in passing through six of these eight classes.

Division III—

Workshops for the special schools for (i) wood-carving, veneer cutting, veneering, etc.; (ii) plaster-moulding, modelling, etc.; (iii) decorative painting, etc.; (iv) ceramics; (v) etching, lithography, etc.; (vi) chasing, leather-carving, etc.

The instruction is given in workshops specially designed for teaching (*Lehrwerkstätten*), and allowing for very thorough instruction in artistic cabinet and furniture making, wood-carving, enamelling, art-metal work, artistic forge-work, art-embroidery, lace-making, and many other similar things.

Division IV—

Special school for girls and women. They may be extensive participation in the above courses or limited courses.

Several examples other than the above have been given in the Report [*see* chap. VIII, secs. 7, 8, pp. 69–71], and the character of the workshops of the Strassburg Art-Industry School is referred to [secs. 18, 19, pp. 77–78].

Associated with these schools there are often artisan schools, as was evident from the chronological table given in the preceding section, *viz.*, sec. 5. These will be referred to later.

7. *Industrial or Technological Museums.*—Many of the Art-Industry Schools and *Kunstgewerbeschulen* are, apart from their own museums of material, closely associated with large industrial or technological museums. The most magnificent example of such a museum is probably the South Kensington Museum (close to which is also the National History Museum), associated with the City and Guilds of London Institute.

One of the finest museums in Germany is the Museum of Art and Industry at Düsseldorf, which has the advantage also of being near the Art Academy. It is in association with the *Kunstgewerbeschule* of that town.

In St. Petersburg there is a "Technological Institute" with its associated museum. Among the important museums seen by the Commissioner may also be mentioned that associated with the Baron Stieglitz School of Drawing in St. Petersburg, constructed in 1896.[3] This is a very fine museum of arts and crafts. The Technical Society of St. Petersburg also has a museum of a similar character.

The great industrial museum of Paris is that of the *Conservatoire des Arts et Métiers*, the galleries of which, with those of the *Palais or Ecole des Beaux Arts*, give a magnificent opportunity to the art-industry student in that beautiful city.

8. *Importance of Technological Museums for Technical Education.*—In Europe all the modern schools have their museums and cabinets of apparatus and material. The collections of the secondary and higher schools are often quite elaborate, and it is fully recognised that this is educationally essential. A museum is just as necessary as a library. Unfortunately, the schools of the State are in most cases very weak in both respects. An

[1] In this State, we do not insist upon proper preparation; hence our grievous failure to progress as we should.
[2] Not professional architecture: that is dealt with in the Technical High School.
[3] A richly decorated building in Renaissance style.

An industrial and technological museum is, as already indicated, an absolutely necessary adjunct of a system of technical education. Its scheme of classification and arrangement is quite distinct from that of a natural history museum, and even where the two contain identical material, they are governed as to organization by relation to the two arrangements, *i.e.*, "systematic" and "economic;" and there is no superfluity, no real overlap.

For Art-Industry Schools, it is necessary that the associated museum should contain a large number of artistic products.

The Technological Museum associated with the Technical College of Sydney is, on the whole, developing on excellent lines, and reflects great credit upon those responsible for its development and arrangement.[1]

9. *Some Statistics regarding German Art-Industry Schools.*—An idea of the magnitude of the work of the Art-Industry Schools of Germany *alone* may be had from the following statistics:—The professors and instructors of the twenty-six Art-Industry Schools in Germany number about 700, *i.e.*, an average of 27 per school; and the pupils 16,000, *i.e.*, an average of 615 per school, or 23 per instructor, that is for both day and evening classes. The students' fees amount to about £13,000 per annum, and the state and municipal subsidy to about £116,000 per annum, in all £129,000, or a little over £8 per pupil, of which less than £1 is paid by the pupil himself. The state subsidy is occasionally exceeded by the municipal, though in general it is much the larger, and rises to considerable amounts. For example, for Dresden it is £9,000 per annum; for München, £7,000; for Breslau, £5,470; for Leipzig, £5,350; for Nürnberg, £5,000. For the two Berlin schools the state, municipal, and other subsidies amount to no less than £14,392, be it remembered, *for Art-Industry Schools alone*, and the subsidies for other forms of technical education are equally munificent.

10. *Art-Industry Schools in other Countries.*—*The Kunstgewerbeschule* of the Imperial Austrian Museum for Art and Industry was established in 1867, and has about twenty-three instructors and 250 students. It has a general division, special schools for architecture, painting, and sculpture, special workshops for chasing, embossing, repoussé work, ceramic decoration and enamel painting, drawing of lace-designs, wood-carving, and a chemical laboratory. The Prague School established in 1885 has much the same organization. [Chap. XII, sec. 12, p. 131.]

Hungary has schools in which the artistic element is also highly developed, among which may be mentioned the schools of decorative art, higher schools of arts and crafts, schools for industrial drawing, etc. [Secs. 14–17, pp. 133-4.]

The Ecole Boulle, Ecole Estienne, and Ecole Bernard-Palissy of Paris, are schools in which there is special training in the artistic side of industry. [Chap. IX, secs. 4–39, pp. 80–91.]

In Italy some very excellent art-industry work was seen at Turin, in the technical schools of San Carlo. These are the outcome of the work of a special society.[2] [Chap. XV, sec. 11, pp. 167–8.]

For similar schools in other countries, see the following passages in the report, viz:—

Portugal, Chap. XV, sec. 18, p. 171. Industrial and professional drawing, etc.

Norway, Chap. XV, sec. 20, p. 172. Kristiania Art and Artisan School.

Sweden, Chap. XV, secs. 24-27, pp. 173–7. Higher art-industry school, school for young women, etc.

United States, Chap. XIX, sec. 25, p. 221. Drexel Institute.

These references are not exhaustive. The United Kingdom has a number of excellent schools of applied art, which are so well known as to not need mention. [Chap. XXXIX, secs. 1–104, pp. 463–517, may be consulted.]

11.

---

[1] In this respect it stands in some contrast with the Technical College itself, which has serious defects.
[2] Società delle scuole tecniche operaie di San Carlo in Torino.

11. *Concluding Remarks on Art-Industry Schools.*—The art-industry products of Germany shew remarkable diversity. Many objects strike one as being artistically crude, but on the other hand there is much that is exceedingly beautiful. The Commissioner had the opportunity of visiting two exhibitions in Europe, the "*Esposizione Internationale d'Arte Decorativa Moderna*" of Turin, and the "*Industrie und Gewerbe, und Deutsch Nationale Kunstausstellung*" at Düsseldorf. The German exhibits in Turin were artistically the finest, better even than the Italian, while those of our own country were very poor in comparison. The artistic work at Düsseldorf, while it preserved the massive Teutonic strength which characterises the public monuments of Berlin[1] and most other German cities, was generally very beautiful.

One cannot but feel that the fruits of the artistic instruction are being harvested, and that a blow is being struck at the welfare of a community by all manufacture which looks only for profit, and is reckless of the beautiful.

Educationists in Europe recognise the fact that art industries require the direction of well-educated and artistically versatile men; of men who have attained to such education as will confer a wide horizon, as well as strong artistic feeling; not merely men who are narrow specialists in a restricted field of industrial art or of art industry.

The one weakness at present in the *Kunstgewerbeschulen* is the often insufficient equipment in the way of educational workshops (*Lehrwerkstätten*). There is a growing recognition in Germany, and also in Italy and Switzerland, that the workshop plays a part in art-industrial education, the importance of which can hardly be overstated. The defect is being rapidly remedied. The new buildings for the *Kunstgewerbeschule* at Dresden will cost £125,000. The Aachen school building, some time back, cost £30,000. It can be taken as the settled conviction of Germany, that workshop education is the essential supplement of the drawing and the theoretical instruction, and that whatever modifications may be necessary in the details of the courses, the art-industry school, substantially as at present organised, is an essential in the educational equipment of a civilised community.

---

[1] The buildings, sculpture, etc., of Paris and Berlin are of a different order of beauty. The former are delicately and subtly beautiful, and are remarkable for piquancy and finesse; the latter for vigour, boldness, and massive strength.

XXIV.

SECONDARY AND LOWER TECHNICAL EDUCATION MAINLY IN GERMANY.

[G. H. KNIBBS.]

1. *General.*—German technical educationists have seen the necessity of combatting a tendency toward a one-sided specialism, which naturally enough perhaps, is distinctly asserting itself in many trades and occupations. The organisation of her technical schools discloses a deliberate and well-considered attempt at correcting this defect. They are thus, not mere trade-schools, but technical schools, aiming at raising German industrial efficiency.

These technical schools, however, are by no means organised on a uniform plan, nor do they all bear a common name. In the following list some of the commoner names are mentioned, in alphabetical order.

Of the secondary order of technical schools the highest and most general in its curriculum is known as a "*Technikum*"; it approaches the level of the technical university. In academic status it must be placed between the *Technische Hochschule* and the *Bangewerkschule* mentioned hereinafter. The professional work of the *Technikum* is often more thorough than in our University.

The following list will give the English significance of the variously named German Technical Schools, as far as it is possible to do so:

Various German Technical Schools.

Baugewerkschule. ...	... School for building trades, or it may be for building and engineering trades and industries.
Bauschule. ...	... School for instruction in building, not architecture, for which latter the course is much more severe.
Fachschule. ...	... A technical school of limited range, or technical school for special teaching in some *Fach* or subject.
Gewerbe-Akademie.	... Academy for instruction in various trades or industries.
Gewerbeschule. ...	... School for the same.
Handwerkerschule.	... Artisan or Handicraft school.
Industrieschule. ...	... Industry school, that is a school for instruction in one or more industries.
Maschinenbauschule.	... School of mechanism or lower grade school of mechanical engineering.
Polytechnische Schule.	... Polytechnical school. A technical school of several divisions or departments nearly of the academic status of the *technische Hochschule.*
Technikum. ...	... Higher grade technical school of several divsions or departments
Technische Schule.	... Technical School.

Sometimes the *Fachschulen* are defined by the subject taught, for example *Steinmetzschule,* stonema ons' school; *Webeschule,* weaving school or school for textile industries.

Various types of technical schools will be referred to separately. 2.

2. *The Technikums and Similar Schools of Europe.*—The Technical High School of Europe is, as stated, a Technical University of the highest grade.[1] The Polytechnical School has in most cases devoloped into the Technical High School. The next grade lower is now the *Technikum*, it is perhaps somewhat less ambitious than the former Polytechnic, but from our standard is a very high grade technical school. In order to give an idea of this type of school, which may well mark the normal development upward of the State Technical College, the Commissioner has given an outline of the *Technikum* of Hamburg in Germany, and Winterthur in Switzerland. [Chaps. VIII and IX.]

The grade of instruction in the *Technikum* of Hamburg is obvious from the nature of the courses, which include (i) higher engineering construction or mechanical engineering; (ii) marine engine construction; (iii) ship-building or lower naval architecture; and (iv) electro-technics. The programmes of these and most of the detailed synopses are given in the Report. [See Chap. VIII, secs. 11, 12, pp. 72–4; secs. 13, 14, pp. 74–5; sec. 15, p. 75; sec. 16, pp. 76–7.] The courses are four semesters or half-years. Such courses disclose adaptation to the local needs of Hamburg. They would perhaps in some particulars be differently arranged in other towns.

It will be sufficient to take an example from one of the courses—say "Electro-technics"—as an illustration, of the general status of the studies.

Subjects in the Electro-technical Course, Technikum, Hamburg.

German.	Steam-engines.
Algebra.	Boiler and heating apparatus.
Planimetry.	Water-motors and small motors generally.
Trigonometry.	Technique of electric currents of low potential.
Stereometry.	Accumulators, etc.
Algebraical analysis.	Electro-technics and technique of electric currents of high potential.
Analytical geometry.	Distribution of electric current.
Mathematical exercises.	Theory of measurement and measuring instruments.
Mechanics.	Constructions and calculations in electric machinery.
Chemistry.	The theory of building construction.
Electro-technics.	First-aid course.
Physics.	Practice in the electro-technical laboratory.
Electro-physics.	
Technology.	
Descriptive geometry.	
Parts of machines, with exercises.	

The extent to which the infinitesimal calculus is taken, is indicated in the Report [sec. 14, p. 75], but is reproduced here for convenience.

Differential Calculus.—Differentiation of algebraic, trigonometrical and exponential functions, the greatest and least values of functions. Apparently indeterminate forms. Application of the differential calculus to the development of series. Maclaurin's and Taylor's series, curve tracing with plane curves, radius of curvature.

Integral Calculus.—Simple integrals, integration by parts and by substitution, integration of algebraic, trigonometrical and logarithmic functions, definite integrals, application to the calculation of the length of arcs, area of surfaces, volume of solid bodies, etc., etc.

It will be seen that this is sufficient for practical purposes, and for creating intelligent notions as to the kind of applications that can be made of this branch of mathematics, and it gives some idea of the grade of the teaching.

The *Technikum* at Winterthur, is the great school of secondary grade in technical education in Switzerland. The account given of it in the report has consequently been made fairly complete. [Chap. XI, secs. 11–17, pp. 117–127.]

It

[1] It works on a higher plane altogether than we do in the professional and technical courses in English Universities. This is the consequence, as pointed out, of the better preparation for entrance.

It has half-year courses in the following subjects, the complete curriculum involving the period indicated in the following list, viz.:—

Courses in the Winterthur Technikum, Switzerland.

	Years.
Builders (*Bautechniker*)	$2\frac{1}{2}$
Mechanical Engineers (*Maschinentechniker*)	3
Mechanics of precision (*Feinmechaniker*)	2
Electrotechnologists (*Electrotechniker*)	3
Chemists—not Pharmacists (*Chemiker*)	3
Art-Industry Workers (*Kunstgewerbe*)	$2\frac{1}{2}$
Surveyors and Agricultural Engineers (*Geometer u. Kulturtechniker*)	3
Officers in Railway Service (*Eisenbahnbeamte*)	2

A sufficient indication of the grade of the instruction may be had by taking say the course in surveying, etc., for the last year. The figures denote the number of hours per week devoted to the several subjects.

CLASS V.

Computations, 2. Calculations of polygons, areas, subdivision of areas, closing, etc. *Surveying*, 4. Areas by various methods, planimetry, subdivision, closing, etc., trigonometrical and barometrical hypsometry, setting out of curves, etc. *Practice*, 10. Surveys covering the range of work theoretically discussed. *Plan Drawing*, 4. Construction of accurate plans of surveys made.

Agricultural Chemistry, 3. Air, water, the soil, plants, their building up from organic materials, nourishment of plants, natural and artificial manuring, manufacture of fertilisers, agricultural products.

Higher Analysis, 4. Differential and integral calculus, specially relating to geodesy, differentiation of simple functions, maxima and minima of functions of one or more variables, with or without approximative conditions, Taylor's theorem, solution of transcendental and higher degree equations by approximation, simple integrals, quadrature of plane surfaces. *Determination of geographical position*, 1. Spherical co-ordinates, geodetic positions.

Geology, 2. Action of water, ground waters, springs, flowing water, talus slopes, alluvial land, formation of mountains, the Alps and Jura, history of the earth's crust, glaciers and moraines, formation of the soil, kinds of soil; excursions.

Theory of Building Construction, 4. Iron constructions, various exercises.

CLASS VI.

Theory of errors of observation, correction by means of the method of least squares, theoretical, 3; practical, 4. Problems in surveying and theory of instruments, average and mean error, the law of development, criticism of errors in linear and angular instruments, levelling, etc., determination of trigonometrical positions, reduction of triangulation by Gauss' method. *Surveying*, 3. Introduction to the important parts of higher geodesy, land surveying cadastral surveying, historical development of surveying, laws and regulations, the "*Cadastre*" (Kataster.)

Road Construction, lecture 2; practice 4. Profile and cross-sections from level surveys, calculations of quantities from vertical and horizontal profiles, disposition of materials, transport tables, width, fall, etc., of railroads and streets, protection, retaining walls, culverts, and small bridges. Design of a street, computation of quantities, small artistic structure, with estimate of cost.

Theoretical Hydraulics, 2. Rainfall, properties of water, soil and water, natural streams, fundamental theory of hydrostatics; efflux through orifices, overfalls, hydraulic measurements, velocity and slope, motion of water in open channels and in pipes. *Practical Hydraulics*, lecture 2. Draining and irrigation, regulation of streams, Swiss torrents. Exercises, 2. Drainage project, simple brook. *Amelioration, Drainage, etc., of a Field*, 4. Development of a scheme for the field of about 15 hectares. *Water Conservation, Canalisation, etc.* Exercises, 4.

It will be obvious to all who know the state of surveying knowledge in New South Wales, that the Swiss "Geometer" is much better educated and trained than his *confrère* in this State.[1]

Europe has abandoned the apprenticeship method of training; that unprogressive and antiquated scheme of acquiring professional or technical knowledge, which cannot possibly lead to good results, since it involves the teaching of novices by instructors who can but rarely be in the first rank of practitioners, and cannot, by any means be theoretical specialists of equal thoroughness with properly-selected instructors.[2]

The Winterthur programmes and synopses of the courses are well worth deliberate study.

The *Technikums* of Hamburg and Winterthur may be regarded as giving a fair idea of this important class of technical school.

The *Baugewerkschulen*, to which reference will now be made, are of an academic status, distinctly lower than the *Technikums*.

3.

[1] The demands made in the Survey Examinations are exacting in some respects, but the academic status of the required knowledge is quite unworthy of the Surveying profession, which clings to the antiquated incompetency of the "apprenticeship" method of obtaining its professional knowledge and training. Some affect to contemn the vastly better methods of Europe, but this can only arise from a complete failure to understand them.

[2] The defects of the existing system were discussed by the Commissioner some time prior to his accepting the Commission.

3. *Schools for Building and Engineering Industry.*—Schools for building and engineering industries are very widely distributed throughout Germany. It is well to reach a fairly accurate recognition of this fact, in order that we may adequately appreciate the extraordinary educational advantages which its people possess. The following is a list of the places where such instruction is provided, viz.:—

German Schools for Education in Building and Engineering Industries.

Town.	Instructors.	Courses.	Extra Courses.
1. Aachen	17	8	Mo, Am.
2. Augsburg[1] ...	18	4	
3. Barmen Elberfeld..	16	4	
4. Berlin	34	4	
5. Bingen	12	4	
6. Bischofswerda ...	9	4	CE, St.
7. Bremen	(?)	4	CE.
8. Breslau	19	4	
9. Buxtehude ...	17	10	
10. Cassel	18	10	
11. Chemnitz[1] ...	12	4	
12. Coburg[1]	13	4	
13. Darmstadt ...	(?)	6	CE.
14. Detmold	12	4	
15. Deutsch-Krone ...	19	4	
16. Dresden[1]	14	4	
17. Eckernfôrde ...	17	4	
18. Erfurt	15	?	
19. Frankfurt ...	20	?	CE.
20. Görlitz	18	4	
21. Gotha	14	4	
22. Hamburg ...	26	4	
23. Hildesheim ...	18	(?)	
24. Holznundin ...	58	4	
25. Höxter	19	4	
26. Idstein	17	4	
27. Kaiserslautern[1] ...	27	4	AI.
28. Karlsruhe B. ...	37	23	CE,RE,P
29. Kattowitz ...	20	10	CE.
30. Köln	14	4	
31. Konigsberg ...	26	12	AE, RE, HE.
32. Leipzig[1]	16	4	
33. Lübeck	15	?	CE.
34. Magdeburg ...	15	4	
35. München ...	19	4	
36. Münster... ...	20	4	CE.
37. Neustadt ...	(?)	4	CE, RO.
38. Nienburg ..	19	4	
39. Nürnberg[2] ...	48	41	
40. Passau[1]	15	12	RE, HE, St.
41. Plauen[1]	7	4	CE.
42. Posen	20	?	
43. Regensburg ...	19	4	
44. Roda	8	4	
45. Rosswein ...	(?)	5	CE.
46. Sternberg ...	15	4	CE.
47. Stettin	18	4	
48. Stuttgart ...	61	16	HE, G, CE.
49. Varel	5	4	
50. Weimar[1] ...	17	4	
51. Wurzburg[1] ...	15	4	
52. Zittau	17	4	CE.

In every one of the above schools the chief subjects of instruction are connected with the building and engineering industries, and they are, as above stated, what are known as *Baugewerkschulen.* Originally they were concerned only with building trades, but as time went on, mechanical, electrical, hydraulic, and road (or civil) engineering[3] (*Tiefbau*), surveying, etc., were added. In the column marked extra courses, "Mo," denotes Modelling; "Am," Ambulance and First Aid instruction; "CE," Civil Engineering, or "*Tiefbau*"; "St," Stone-cutting; "AI," Industrial Art; "RE," Railway Engineering; "P," Pædagogy, or training for technical instructors; "AE," an elementary form of agricultural engineering; "HE," Hydraulic Engineering; "RO," a course for railway officials; "G," a course in elementary geodesy or rather surveying.

There is practically one well-organised school of this type for each million of the population. The Stuttgart School, founded in 1832, is the most important and flourishing, a fact which has been recognised at South Kensington. Its building cost £42,000, that is, of course, without site or equipments. 4.

---

[1] Denotes that the instruction lasts during the Winter Semester only.

[2] Day instruction in Winter; Evening instruction, Winter and Summer.

[3] The technical terminology in German is peculiar.
Bau denotes building or construction.
Hochbau, high building, is building in the usual English sense.
Tiefbau, deep building, includes such work as road, street, and railway construction, and sometimes also hydraulic and bridge construction, drainage works, canal construction, etc.
Wasserbau, water building, denotes hydraulic construction.
Maschinenbau, machine building, is machine construction or mechanical engineering.

4. *Instruction in Building and Engineering Schools.*—The aim of the courses is to qualify persons who are then known as "*Techniker*" in the secondary grade of knowledge, such as the following, viz.:—

Master builders (*Bauwerkmeister*); building officials or building surveyors for districts and towns (*Oberamtsbaumeister*, *Stadtbaumeister*); road, street, fire-prevention, and railway inspectors, lower grade hydraulic engineers, lower grade mechanical engineers, managers of mechanical workshops and factories, overseers, mechanical draftsmen, builders of mills, public surveyors (*Geometer*); experts in drainage and irrigation.

The organisation of the instruction and conditions of entrance differ somewhat from those obtaining in the technical high schools, being much less exacting for most subjects.

Students who take up surveying, drainage, and irrigation are required to possess higher school qualifications than those who take up the building and engineering courses.

In order that the courses may be regular and profitable, there is preliminary instruction in the mother-tongue—drawing, elementary science, and mathematics.

The curriculum for the Stuttgart School is not given in the Report, but the organisation and curricula of the *Baugewerkschule* and *Technikum* of Hamburg will give a sufficient idea [chap. VIII, secs. 3-5, 10-17, pp. 65-7, 72-77], the latter, already referred to, making the contrast between the schools.

5. *Teaching Staff of German Schools for Building and Engineering Industry.*—The organisation of the teaching staff is worthy of note. It consists of the following, viz.:—(1) Principal instructors or professors (*Hauptlehrer*)[1]; (2) Assistant professors (*Hilfslehrer*); (3) Masters of special subjects only (*Fachlehrer*); and (4) Assistants. The Head of the school is always the "*Direktor*." At Stuttgart, the Director and two Councils discuss all questions affecting the school. These Councils are (i) the "*Lehrerkonvent*," consisting of all the principal professors; and (ii) the "*Lehrerausschuss*," or smaller committee of principal professors. The latter deals with minor questions, and acts as an advisory committee to the Lehrerkonvent. The professors, Director, or larger Council may reprove students for breaches of discipline.[2]

The staffing is generous, as the following example for Stuttgart will disclose:—

Teaching Staff of the Stuttgart Building and Engineering Industry School.

Subjects.	Principal Professors.	Assistant Professors, Masters, etc.	Subjects.	Principal Professors.	Assistant Professors, Masters, etc.
Building, Architecture	10	4	Languages	2	2
Applied Mathematics, Practical Geometry, Civil Engineering.	3	2	Caligraphy	...	3
			Fire-prevention	...	1
Mechanical Engineering	3	7	First Aid, Ambulance work ...	...	1
Surveying, Drainage, Irrigation ...	2	5			
Ordinary and Technical Chemistry...	1	1	Total	29	32
Mathematics and Physics	6	4			
Freehand Drawing, Modelling ...	2	2	Grand total	61	

For 20 Prussian schools of the same type, there are 19 Directors, 320 professors and instructors, and 20 minor assistants. In 22 Prussian schools there were 4,986 students in 1902, an average of 227 each, and an average of about 13 students for each teacher.

6.

[1] These are practically of professorial rank, and have the same status as the instructors in the *Gymnasien*, on whom, as it has already been noticed, the legal title "*Professor*" is often specially conferred.

[2] The discipline regulations are of interest. They are as follows:—(1) Simple reproof by a professor or instructor; (2) reproof by Director or larger Council; (3) confinement for various periods in the "*Carcer*," or students' prison; (4) withdrawal of scholarships, or other similar benefits; (5) threat of expulsion; (6) temporary expulsion; (7) permanent expulsion.

6. *Equipments, Libraries, etc.*—The *Baugewerkschulen* are not equipped in the lavish manner which one sees in the Technical High Schools; nevertheless, their equipments are good and fairly liberal. The *collections* for the illustration of building and constructional mathematics, mechanical and electrical engineering, chemistry, physics, surveying, etc., at the Stuttgart School is worth at least £3,000. The school *library* is valued at £5,000. There is also a permanent exhibition of the best work of the students, the value of which must be considerable.

7. *Generous Treatment of Students.*—The fees at Stuttgart are about £2 10s. per semester (£5 per annum), and able students in indigent circumstances may have the whole or part of these remitted. Excursions are made for inspection and sometimes for practical work, to manufactories, buildings, and works of various kinds. These may be for a few hours, a half-day, or for longer periods, lasting even a week. *The travelling expenses are borne by the school.*[1] The terms occupy about 200 days, leaving the balance free for the student to earn his living, if needs be, especially in practical work, often in character similar to that in which he is receiving instruction. The long vacations are in summer, when building operations are proceeding; so that the pupil is able to get both practical experience and theoretical instruction on what has been called the "sandwich system," and is able to earn at the same time.[2]

8. *Important plane of cleavage between the Technical University and the Technical or Industry School.*—Wherever education is slovenly, lacking in thoroughness, ill-organised, or not organised at all, it necessarily follows that there are no well-defined planes of cleavage between one form of school and another; so we find in this State a widely-prevailing impression that there is only an arbitrary distinction between one class of school and another. The experience of Stuttgart is important in discussing the question of possible relations between the University and the "Technical Colleges" of the State.

Owing to the expense of learning privately, the Stuttgart School was founded in 1832 as a trades school, and raised in 1840 to the rank of a polytechnical school. It was, however, found that *advanced and secondary technical education in the one institution did not harmonise,* so that a new building trades school was established in 1845, and later the polytechnic became a technical high school. This institution was originally a *Winterbaugewerkschule,* but in 1865 summer classes were also established.

As soon as we aim at thoroughness in education in the least degree comparable to that of Germany, the planes of cleavage between different classes of schools will be found to become more distinct; and those educationists who are ignoring this are doing very serious injury to the educational future of Australia, and are injuring our national destiny.[3]

The difference between the Technical University and the Technical School should be more radical than is implied by the merest smattering of Latin, and what the experience the whole of the Continent of Europe has shewn is this: that the highest planes of technical education must be not merely of the University type, but founded upon a thorough and severe preparatory education, and one which is *not* requisite for entrance into the trade or industrial school.

9. *Other Courses in Lower Civil Engineering and in Building, etc.*—An example is given in the Report of a Lower Civil Engineering course of two years in Berlin [Chap. VI, sec. 18, pp. 45–6]. It involves 48 hours a week study.

The industrial technical schools of *Japan* have courses in mechanics and engineering, electro-mechanics, etc.; ordinarily of three years' duration. [Chap. XV, secs. 14, 15, pp. 169–170.] The

---

[1] On our State railways it would be a considerable advantage if *bonâ fide* students and teachers were carried free, for the purposes of receiving or giving instruction. This will be referred to later.

[2] The expenditure in which a student is involved has been given by Dr. F. Rose, H.M. Consul at Stuttgart (Cons. Rept., Nov., 1903, No. 600, p. 23). It is as follows:—Fees, 2 terms, £5; materials, drawing, books, £3; bed and sitting-room combined, with board, say 8 months, £27 10s.; fuel, light, service, £3 10s.; miscellaneous, £11; total, £50.

[3] Persons who have neither made a serious study of the various forms of educational organisation in the world, and who are practically unconscious of the astonishing advances of other countries, do not hesitate to decide the whole matter off-hand. This, of course, is characteristic.

The Technical School of Stockholm has a professional school of building and architecture, a school for mechanics, as well as evening and Sunday morning courses, etc. [Sec. 24–30, pp. 173–8.]

For accounts of Technical Schools in Russia, America, the United Kingdom, see the Report. [Chaps. XVII, pp. 185–192 ; XIX and XX, pp. 214–235 ; XXXIX, pp. 463–517.]

10. *Expenditures for Building and Engineering Industrial Education.*—In referring to the expenditures involved in the type of technical education referred to in the preceding sections of this division, it should be remembered that it is only a mere section of the total technical education provided in Germany. The following will give some idea of *the measure of the interest of the German Government in the education of the people.* The State aid for the Stuttgart *Baugewerkschule* for 1901 and 1902 was as follows, viz. :—

1901—£10,936, with income £3,526, making total expenditure of £14,462.
1902—£10,844, „ „ £3,709, „ „ „ £14,553.

The Karlsruhe School receives—

1902 (?) —£7,250, with income £1,250, making a total expenditure of £8,500.

The Prussian schools of the same character are subsidised to the amount of £75,000 per annum by the State alone.

11. *German Schools for Metal Industries.*—There are a number of schools for education in various branches of metal industries in Germany, which are indicated in the following list :—

German Schools for Education in Metal Industries.

Place.	Industry.	Date.
1. Aue, Saxony	Sheet-metal, metal spinning	1877
2. Iserlohn, Prussia...	Bronze goods	1880
3. Remscheid, „	Steel and ironware	1882
4. Hannover, „	Copperware	1893
5. Rosswein, Saxony	Artistic iron work	1894
6. Siegen, Prussia	Steel and ironware	1900
7. Schmalkalden, Prussia	„ „	1901
8. Hanau, Prussia	Work in precious metals, jewellery, etc. ...	1772
9. Furtwangen, Baden	Clocks, watches	1878
10. Glashütte, Saxony	„ „	1879
11. Swhenningen, Würtemberg	„ „ and electro-technical appliances	1900
12. Nürnberg, Bavaria	Mechanical work generally	

It will suffice to mention the course in one or two cases. At *Remscheid,* for example, where the instruction is both theoretical and practical, the latter consists of carpentry and joinery; forge work with iron and steel, work in the fitting and turning shops, surface treatment, grinding, burnishing, polishing, lacquering, etc.; galvanising ; tinsmithing ; sheet-metal work ; metal stamping ; moulding ; casting ; electric welding ; welding by the Bernados process ; work in the electro-technical laboratory ; the care of boilers, steam and gas engines. The classes are of three years' duration, and the theoretical instruction embraces the following, viz. :—The mother tongue ; book-keeping : commercial geography ; political economy ; ordinary computation ; freehand, linear, building, architectural, and machine drawing ; algebra up to solution of second degree equations, and the representation of ordinary curves; trigonometry with solutions of triangles and polygons ; sketching objects ; descriptive geometry; kinematics, statics, dynamics, and hydro-mechanics; strength of materials; physics, viz., matter, hydrostatics, aerostatics, heat, thermo-dynamic theory; acoustics; optics ; general chemistry ; metallurgy of iron, steel, important metals technically ; mechanical technology, treatment of iron and steel, tools, rolling mills, foundries,

tools

tools of fitting shop, machine tools; prime-movers, wind and water motors, steam and gas engines; electro-technics, magnetism, electricity, current, chemical action, resistance, thermal effects, lighting, electro-motors, power-plants, etc.; building construction; architectural drawing, first aid course.

The hours average about 28 per week for theoretical instruction and about 26 for workshop instruction, say, about 54 per week for both, and the work is *uniform for all pupils*. The motive power is derived from a steam, a gas, and a petroleum engine, and an electro-motor supplied from the street mains.

The comprehensive character of the course is manifest; the syllabus is genuine, and the teachers are efficient.[1]

The other courses are equally finely developed.

Reference to similar schools in other countries may be found in the Report [Chaps. VI, VIII, IX to XIII, XV to XVII, XIX, XX, XXX, XXXV, and XXXIX; see synopsis hereinafter].

12. *Expenditures on Schools for Metal Industries.*—The following expenditure will help to disclose still further the liberality of Germany's provision for technical education. The following cases are drawn from the schools referred to in the preceding section:—

Siegen School: Building, £12,500; equipment, £10,000; total, £22,500.

Schmalkalden School: Building, £6,500[2]; equipment, £4,100[3]; total, £10,600.

Furtwangen School: Building, £3,000; equipment, £3,825; total, £6,825.

Many of the schools are, of course, humbler than these.

The *Hanau* School receives State subsidy £3,923 and fees £630; total £4,553. The *Schmalkalden* receives a municipal subsidy of £250 and State subsidy £1,000. The *Remscheid* receives municipal subsidy £200, provincial £500, and State £1,800.

The following is of special interest. The income of the *Glashütte* School of Saxony includes: Sale of school work, £313; repairs by students, £46; *aid from industrial associations*, £224.

13. *German Schools for Wood-working Industries.*—Germany possesses also a number of schools for wood-working industries, which are indicated in the following list:—

Wood-working Schools in Germany.

1, Berchtesgaden; 2, Berlin; 3, Bischofsheim; 4, Flensburg; 5, Furtwangen; 6, Fürth; 7, Kötzting; 8, Leipzig; 9, Neuhammer; 10, Oberammergau; 11, Partenkirchen; 12, Warmbrunn.

The wood-working represented is carpentry, artistic carpentry, cabinet and furniture making, wood-turning, carving, etc. For practical instruction, there are workshops connected with the schools. The theoretical instruction usually consists of linear, freehand and ornamental drawing, modelling, carving, turning, carpentry and cabinet making.

Instruction is given (i) in the subject-matter itself; (ii) as regards the machinery employed; (iii) as regards the materials used; (iv) in chemistry as applied in the industrial work—for example, as to the action of alkalies, acids, chlorine, vegetable and aniline dyes, tanning materials, etc.; (v) in staining, bleaching, varnishing, waxing, polishing; (vi) in the chemistry of wood. An excellent example of such instruction is translated from the syllabus of the *Hungarian* schools. [Chap. XII, sec. 27, pp. 139–140.] 14.

[1] Whether an excellent syllabus means much or little depends upon the character of the instructor whose teaching it professes to represent. The significance of this observation will be thoroughly understood; a syllabus is make-believe without a sufficiently educated, trained, and accomplished teaching staff. The German training *is* thorough.

[2] Borne by municipal authorities.

[3] Borne by State.

14. *The Character of Buildings for various Special Technical Schools.*—In order to give a sufficiently vivid idea of how real is the continental belief in education, the Commissioner has given photographs shewing several Hungarian technical schools, viz. :—

Illustrations of Technical Schools.

(1) The Special School for Wood and Metal Working at Arad, Chap. XII, p. 148.
(2) " " " " Szeged, " p. 149.
(3) " " " " Kolozsvár, " p. 149.
(4) The Higher School of Arts and Crafts, Kassa, Chap. XII, p. 150.
(5) The School of Decorative Arts, Budapest, Chap. XII, p. 150.

They are all handsome, well-designed buildings.

15. *Other Forms of Special Technical Instruction.*—The instruction in Germany in connection with the textile industries is of three grades, viz. :—

(i) Higher, given in connection with the courses in technology at the ten technical high schools.
(ii) Secondary, given at a large number of technical schools for spinning, weaving, dyeing, finishing, etc.
(iii) Lower, given at a large number of small weaving, spinning, knitting, and embroidery schools.

Regarding (i), it may be stated that special attention is paid to this branch of instruction at both Aachen and Braunschweig.

In Prussia alone there are secondary schools at 15 localities ; there are 4 in Württemberg ; 18 in Saxony ; 4 in Bavaria ; 1 in Hesse-Darmstadt ; 2 in Reuss ; and 1 in Elsass ; that is to say, 47 in all.

No less than 22 small weaving, knitting, and embroidery schools are to be found in Prussia ; 3 in Württemberg ; and 5 in Saxony ; making a total of 30. Besides this there are 28 braiding and plaiting schools ; making a grand total of 115 localities where some type of this form of instruction is provided.

Some idea of the magnitude of this branch of technical education can be had from considering the following facts, viz. :—

At 15 schools the ordinary expenditure amounts to about £40,000. There are about 57,000 works employing two or more persons, and 32 over 1,000 persons. The looms in Germany number about 212,000, the horse-power used is 515,000, and the persons employed 993,000. As far back as 1895 Germany exported £39,000,000 of textiles. She imported in 1902 no less than £63,000,000, and exported £57,000,000; it is estimated that the production in her textile industries in 1902 represented about £115,000,000.

The total number of technical schools throughout Germany is very large, and they are very varied in character. Berlin itself has a considerable number. [Chap. VI, secs. 1–43, pp. 30–54.] There are, for example, a number of preparatory mining schools (*Bergvorschulen*), 43 in Prussia alone, 46 altogether ; and also lower grade mining schools, 11 in Prussia alone, and 14 altogether ; two metallurgical schools, schools for glass-staining and glassware ; for wood-carving, for special carving and turning, ivory, wood, etc. ; book-printing[1], for inland navigation[2], chemical and apothecaries' schools, horse-shoeing[3], photographer's, basket-maker's, fitter's, tailor's, tanner's shoemaker's, gilder's, miller's, and many other schools.

Germany has recently determined that the art of bootmaking shall be improved, and in 1903 opened a Bootmakers Technical School at Wermelskirchen. There is also a Tanners' School at Freiberg, opened in 1889. These will be referred to in next division of the summary.

16. *General Conclusions as to the Attitude of Germany towards Technical Education.*—One cannot study the Technical Schools of Germany in the country itself and fail to recognise that there is a belief in the national value of all forms of education that is if not wholly wanting in us, is at least sadly deficient in comparison.

Let

[1] One in Leipzig, one in Stuttgart.
[2] Seven in Saxony, three in Baden.
[3] Forty-seven in Prussia, five in Baden, seven in Bavaria, one in Mecklenburg-Scheverin ; *i.e.*, 60 altogether.

Let us examine for a moment the educational equipment of a little State like Württemberg, with a population only one-third greater than our own, in an area not $\frac{1}{41}$ that of our State, and with a revenue only $\frac{2}{5}$ of ours. The information in the following table will afford the material for comparison :—

Educational Expenditures in Württemberg.

State of New South Wales :—Population, 1,500,000 ; Revenue, £11,300,000 ; Area, 311,000 square miles.
Kingdom of Württemberg :— ,, 2,000,000 ; ,, £4,500,000 ; ,, 7,531 ,, ,,

Institution.	State Aid for 1901.[1]	Institution.	State Aid for 1901.[1]
	£		£
State University at Tübingen	55,000	Viticultural School	1,500
Gymnasia, Lyceums and Latin Schools ...	35,000	Industrial Improvement Schools ...	15,000
"Real" Schools	15,000	Male Teachers' Training Institutes ...	19,000
Technical High School	20,000	Female Teachers' Training Institutes ...	5,000
Agricultural High School	10,000	Folk-Schools	13,000
Veterinary High School	5,500	Additions to salaries of masters at Gymnasia, Lyceums, Latin Schools, Real-Schools, and Folk-Schools	166,000
School for Building and Engineering Industries	10,800		
Art-Industry School	5,000		
Art School and Art Collection	7,200		
Spinning and Weaving School	3,200	Grand Total ... £	386,200

This State aid is merely the annual contribution of the State to *ordinary expenditure.* It may be compared with ours in the following manner, viz. :—

Institution.	New South Wales.		Württemburg.
	£		£
Sydney University[2]	14,000	against	55,000
Technical Colleges[2]	about 39,000	,,	(say) 78,000
Training Schools	,, 5,100	,,	,, 24,000
Grammar Schools[2]	,, 1,500	,,	,, 50,000

To grasp the significance of these figures properly it has to be remembered that educational expenditure in all new countries must be large on account of the small density of the population.

When the whole matter is carefully studied comparatively, it will be recognised that the measure of opportunity for technical education, which is afforded the young people of the State, is wholly insufficient, and fails to express any vigorous belief in the wealth-creating power of a good educational system.

Germany's provision for higher, *technical*, secondary, and primary education expresses, in a vivid and practical way, her belief that expenditure on the education of a people pays, and is the necessary foundation of great national success, and there is no doubt whatever that she is reaping her reward in a colossal growth of industrial power, the significance of which is obvious to every intelligent student not blinded by insular vanity or irrational dislike.

[1] This does not by any means represent the total cost of the several schools, for the State bears only part of the total cost.

[2] The cost of the public high schools ought perhaps to be added to this. It will not greatly modify the discrepancy, however.

XXV.

MISCELLANEOUS FORMS OF TECHNICAL EDUCATION.

[G. H. KNIBBS.]

1. *Introductory.*—It is proposed in this Division to discuss two types of technical education which have recently become of interest and importance, and also to refer to some miscellaneous branches of technical instruction.

2. *Importance of the Leather Industries.*—The importance of the Leather Industries can be gathered at once from the fact that the following number of animals are slaughtered annually in New South Wales[1] :—

Sheep and lambs, 3,280,000; cattle and calves, 275,200; swine, 178,000, gives thus about 3¾ million hides and skins from this source alone. We have, however, only about 100 tanneries, employing a little over 1,000 hands, in the State. About 6,000 hands are, however, engaged in the boot trade. A school for tanning and dyeing leather, and a school for boot-making, are obviously desiderata.[2] Germany gives the cue for such instruction in two schools referred to in the preceding division; and it may be mentioned that in the Yorkskire College, Leeds, a Leather Industries Department has been recently fully organised and finely equipped.

3. *The Tanning School of Freiberg, Saxony.*—A technical tanning school was opened in Freiberg in 1889, for students of not less than 17 years of age, who possess a fair practical experience of tanning. A limited number are also received who do not possess such practical knowledge: these must acquire it at the school, and pay extra fees therefor.

The course lasts one year, and involves from 44 to 51 hours work per week. It covers the following subjects, viz.:—

1. Tanning and dressing; pit, and modern methods of tanning; use of solutions and extracts; currying, dyeing, exercises with tanning machines: 10 hrs. per week.
2. Technical lectures on tanning: 3 hrs.[3]
3. General chemistry, inorganic and organic, with special reference to tanning materials, fermentation and decomposition. 6–7 hrs.
4. Practical chemistry, reagents, acids, bases, salts, determination of value of tanning materials extracts, fats, chrome salts: 4–6 hrs.
5. Tawing, grease, mineral, and chrome tanning: 1–2 hrs.
6. Leather dyeing, during half year only: 1–2 hrs.
7. Physics, specially orientated with reference to subject: 1–2 hrs.
8. Microscopy, specially applied to tanning materials, the hide and its changes, etc.: 1–2 hrs.
9. Machines and power, motors, tanning machinery, drying, heating, and ventilating; installation of a tannery, necessary buildings, etc.: 1–2 hrs.
10. Drawing, applied to objects in tanning, machinery and buildings, design of installations: 2 hrs.
11. Book-keeping, technical and mercantile: 3 hrs.
12. Commercial instruction, general and special: 2 hrs.
13. Political economy. Industry; general and leather industry, etc.: 1 hr.
14. Mercantile arithmetic, specially applied to leather industries: 2 hrs.
15. The mother tongue; correspondence, business exercises: 2 hrs.
16. First aid, etc.: 1 hr.

The

[1] From "Statistical Register," 1903.
[2] The consideration of the establishment of these is engaging the Director of Technical Education at the present time.
[3] 3 hrs. denote 3 hours per week; similarly throughout.

The fees for Germans are £10 for theoretical and £10 for practical instruction and £1 10s. for use of laboratory; for foreigners, double these amounts.[1]

The school is subsidised annually, as follows:—

State, £250; town, £125; local leather industry, £200; total, £575.

Although it had nearly 80 students in 1903, of which more than half were foreigners, it could not pay its way without subsidy.

4. *The Bootmakers' School at Wermelskirchen, Prussia.*—The Bootmakers' Technical School at Wermelskirchen, the first school in Germany to meet the demand for instruction in the trade under modern conditions, was opened in 1903. It is intended for the instruction of managers, foremen, pattern-cutters, and workmen generally, the minimum age of entrance being 16. The courses are:—

(1) For managers, 2 years, *i.e.*, 84 weeks of 44 hours each.
(2) For foremen, 1 year ,, 42 ,, ,, ,,
(3) For workmen, attend special branches of instruction only.

The fees are five times as great for outsiders (*Ausländer*) as for Germans. Spoilt raw material must be paid for by all students.

The course includes freehand drawing; pattern-cutting by hand and with machines; shaping, laying-out, and cutting the leather; examining raw material; tanning; technical computations; preparation of parts cut out; stitching, finishing, binding, machinery and drawing, wages, computation, management, machining, finishing, etc.; anatomy of foot; foot troubles; special lasts for these, etc., etc.

5. *Leather Industries Department, Yorkshire College, Leeds.*—An account of a new feature in English Technical Instruction, viz., in the Leather Industries, is given in the Report, [Chap. XXXIX, sec. 12, p. 469]. This department in the Yorkshire College, Leeds, is very well equipped.[2] It occupies three floors, and contains a lime-house, tan-house, dye-house, machine-room, and curriers' shop, engine-house, research and students' laboratories, museums, store and drying rooms.

The chief course is of three years' duration. The subjects of study required for the first year are chemistry, work in the chemical laboratory, general engineering, mechanical drawing, German or French, a short course of physics, if possible; for the second year, general principles of tanning, organic chemistry, German or French, work in the organic chemical laboratory, and leather industries laboratories; for the third year, mineral and special tannages, the chemistry of leather manufacture, currying, dyeing, and leather finishing, technical microscopy, and bacteriology.

There is also a two-year course, qualifying for the college certificate in leather manufacture.

To become a member of the International Association of Leather-trades Chemists, it is necessary first of all to take the B.Sc. Degree course in Chemistry, and at least a final year in the Leather Industries Department.

6. *Nature and Function of Apprentice Schools.*—The whole course of modern technical education reveals how incomparably better it is qualitatively, to say nothing of its economy of time, than the old scheme of training by apprenticeship. That is a settled matter in Europe, even apprentices must receive technical instruction. An opinion is frequently expressed in this State, however, that apprenticeship, if only properly carried out, would be the best form of training. Thus in the press recently we read an article entitled "Technical and Practical Education" the following, viz.:—

"The lad apprenticed to a good tradesman surely receives the best of all technical education. He sees how all things in the trade are done, he helps to do them, and is even allowed to carry on some little work solely on his own account."—*Sydney Morning Herald*, 26th August, 1905.

The

---

[1] It is only natural that foreigners should be asked to pay for instruction that is given *at less than cost*; it may be mentioned that at Hohenheim Agricultural High School, foreigners are educated at a loss to the State of £2,200 annually, reckoned even on current expenditure only.

[2] A considerable amount of experimental work was proceeding at the time of the Commissioner's visit. Original research is also undertaken.

The writer was evidently acutely conscious of the essential nature of the defect of much of the work of the Technical College of the State. But his judgment on the main point is nevertheless erroneous. Properly organised technical education can produce *better* workmanship, in less than half the time required by apprenticeship, and hence is the only technically and economically sound system—in fact, the only system which can be tolerated by an intelligent nation that desires to keep abreast of its competitors. This has already been referred to in this summary [III, §§ 2–6], and is also discussed in the Report [Chap. III, secs. 1–13, pp. 7–14.]

From this point of view technical schools may be divided into three classes, viz. :—

(1) Schools which give *theoretical technical instruction* only, in order to constitute, with the practical instruction received by apprenticeship, a fairly complete scheme of technical training. This theoretical instruction is designed, moreover, to broaden out somewhat the pupil's outlook, and thus to make him a more intelligent workman. These schools are usually evening schools.

(2) Schools which provide both *theoretical technical instruction* together with a certain amount of *manual training*—more or less directly associated with the particular trade or calling—and with exercises in the *practical work* of the calling itself. These are sometimes evening schools, sometimes both day and evening, and the custom is growing up in many places of allowing apprentices a portion of the day to attend such schools.

(3) Schools with a complete scheme of correlated *theoretical and practical technical instruction,* such that the two elements are properly co-ordinated throughout. These are almost invariably day-schools.[1]

These three schools stand in the order of increasing efficiency, (3) being the ideal school. It may appropriately be called an *apprentice-school* or *school of apprenticeship,* in contradistinction to a mere school for apprentices.

The function and purpose of this last type of school may therefore be defined to be the creation in the minimum time of thoroughly educated and accomplished craftsmen. No one can compare the work done in this type of school in, say, less than three years, with what is done by apprentices who have served seven years without observing how inferior is the apprenticeship system.[1]

7. *Examples of Apprentice-schools.*—All schools of type (3) above may be included in this category. Several specially fine schools are referred to at considerable length in the Report, some of which, not already mentioned in this summary, may now be referred to. As an illustration of the details of the organisation of an apprentice-school, the scheme of the *Lehrwerkstätten* of Berne, the administative capital of Switzerland, affords an excellent example. This will be found in an early part of the Report. [Chap. XI, secs. 7–10, pp. 110–7.] The school was founded as a corrective to the necessity of employing foreign labour, which was more skilled than Swiss. The account mentioned refers[1] to the general organisation of the school; the duration of apprenticeship; the conditions of admission; form of indenture; obligations of the town, apprentices, and guardians; and the theoretical and practical instruction in mechanical engineering, joinery, locksmithing, etc. A few illustrations of the students' work are given. [Pp. 114, 115.]

In France such schools as the *Ecole Diderot,* which was one of the earliest in Paris to form "well-instructed and skilful workmen, capable of earning their living on leaving the school" [Chap. IX, sec. 3, pp. 79–80], and which gives instruction in

[1] There is another class of school which assumes that the student has had some practical experience.

[2] Of course, natural genius here and there has produced great artists in their work: no system of education can confer genius or compete with it. Systems of education merely propose to deal with average human beings in whom impulses of genius are so weak as to necessitate their powers being educed by a scheme of training; *i.e.*, by education.

in forge-work, metal-turning, fitting, fine mechanism, pattern-making, carpentry and joinery, locksmithing, brazier's work, and plumbing, and the *Ecole Boulle* for furniture and cabinet-making [sec. 4, pp. 80–1] are worthy of special study.

The celebrated *Ecole Estienne* for all branches of book-printing, binding, illustration, etc., is almost a model of perfect organisation. [See secs. 6–38, pp. 81–91.]

The Report will be found to be replete with excellent examples of every type of such school.

8. *The Tendency of Modern Technical Education.*—A careful review of the changes which are rapidly taking place in the organisation of technical education throughout the world point to the fact that systematic, theoretical, and practical instruction is superseding education by apprenticeship. As was explicitly recognised in France [Chap. IX, secs. 1, 2, p. 79], the apprenticeship system is inconsistent with national welfare,[1] because it is economically wasteful, and technically crude. Practical experience must, of course, ever be associated with theoretical instruction, but throughout almost the entire range of trades and craftsmanships, it is possible, and it would be *unconditionally advantageous*, to so organise technical education that the theoretical and practical instruction shall be received in a systematic way, the two being co-ordinated. This can be done properly only in well-equipped schools, *i.e.*, schools equipped for both the theoretical and the practical elements of the instruction. These, and these alone, can qualify us to cope with technical education as now organised in most European countries, particularly Germany. The tendency to substitute thoroughly organised systematic technical education for the crudities of apprenticeship is practically world-wide.

9. *Miscellaneous Forms of Technical Education.*—There are very many technical courses to which reference might well be made, and which are treated at length in the Report. For women, for example, may be mentioned the following, viz. :—

Subjects.	Chapters.	Sections.	Pages.
Plain and Art Needlework, etc.	XXXIX	49, 50	491–2
Dress and Costume making	XXXIX	48	491
Lace and Passementerie making	VI	13	37–8
Manufacture of Artificial Flowers	IX	54	95–6
Domestic Economy	XI	5, 6	107–9
Housekeeping	XIII	5, 7	152
Cooking	XX	28	230
Training for Nurses	XX	35	231–2

This list is, of course, only illustrative. The four-year course of cooking at the Tuskegee Institute, Alabama, is specially worthy of mention [Chap. XX, sec. 28, p. 230], in fact, the whole series of courses in the Department of Industry for Girls [secs. 24–35, pp. 229–232], Domestic Economy, Cookery, various forms of Manual Training, etc., and continuation schools for extending ordinary education, supplementing it or preparing the pupil to enter upon courses demanding definite preparation,

[1] The deplorable hostility of workmen to the multiplication of the numbers of those in their own ranks has happily passed away with a clearer perception of the certainty of the nationally disastrous effects thereof. [See Report, Chap. IX, sec. 2, p. 79.]

preparation, etc., are all discussed with sufficient fulness in the Report, and need not be treated in detail. In continuation schools, natural science and drawing are often conspicuous features.

Merely elementary forms of dressmaking, simple cooking and domestic economy, etc., may properly be taught in the primary schools, as a preliminary to more thorough teaching under the general scheme of technical education.

10. *General Observations.*—Taken with this Summary, the Report will afford something like a definite idea of the organisation of technical education in the United Kingdom, Continental Europe, and America. It will be seen that the great characteristics of good technical education are *thoroughness* in the qualification of the instructor, the creation of a properly *organised system* of theoretical and practical instruction, and properly *equipped schools*, and that many of the technical schools of modern Europe approach the ideal in these several respects.

So fully is it now recognised that the technical instructor must be an intelligent educationist, as well as technically skilful, that special courses are being instituted for his professional training.[1]

The notion of becoming technically competent by attending lecture courses has vanished. Technical skill involves hand and eye training, as well as mental culture. Technical education is learning to *do*, not merely to know about, the things with which it is concerned.

---

[1] It is supposed by some that the ordinary primary teacher of the future will be competent to *teach* arithmetic, algebra, geometry, mensuration, drawing, English, grammar, elocution, geography, elementary physics and chemistry, botany, and geology—in Nature Study—a little elementary astronomy, cookery, and needlework, or modelling, manual training, physical culture, gymnastics, and possibly a few other subjects !

XXVI.

DEFECTS OF TECHNICAL EDUCATION IN NEW SOUTH WALES. CONCLUSIONS—RECOMMENDATIONS.

[G. H. KNIBBS.]

1. *Introductory.*—Perhaps the most valuable result of a comprehensive study of the organisation of technical, as of any other branch of education, is the general impression one carries away from such study. The Commissioner has now had, not only the advantage of personally visiting, under the most favourable circumstances,[1] the installations for trade and general technological instruction throughout the various countries visited, he has also had the opportunity of following this visit by a close and prolonged study of the whole question, a study covering, naturally, a much wider range than is represented in this lengthy report. For the report, after all, is a mere selection from an almost bewildering mass of educational material. The general impression is, however, decisive: it is that *our whole scheme of technical education here wants reforming*, whether it is that given in the University or in the technical colleges. Is this verdict a just one?

It has been shewn, in the first Report, that the *Primary system* of the State was behindhand in almost every important particular, and however unpalatable that fact is—and it is deplored by no one more than the Commissioner here writing—its truth will be evident to any impartial and competent inquirer who will take the trouble to weigh, not the *dicta* of the Commissioner, but the evidence of the facts quoted in the Report.

To grasp that truth is the first requisite in any attempt to reach the urgently-required reform of our whole educational system: a reform of its traditions, instincts, methods, of its whole atmosphere: a reform which, if it come about, will completely remodel the whole drift of education in this State, and leave a very different public impression as to the value of education for the people, and of the tremendous part it must play in the future destiny of Australia.

In the Report on Secondary Education, it was shewn, again by an overwhelming mass of evidence—evidence which it is easy to see is completely independent of the Commissioner's personal judgment—that, comparatively, we are even worse off than in regard to Primary education. This is but natural, and is to be expected, because as one observes the higher reaches of an educational system the differences become more startling. Naturally again, insular and personal feeling and resentment have been aroused. But surely our national danger, from failing to realise our true educational status, will not tolerate anything but the truth. It is in that, and in that alone, that safety can lie. We run the risk of deceiving not others, but ourselves only. Our great competitors know exactly where we stand. A friendly critic says, touching this matter:—

> "The German on leaving school possesses actual general knowledge of nature, history and literature, whilst the average Briton, male or female, all his life remains, as compared with our standard, a person of very poor attainments. Admitted that the value of mere book-learning may be over-estimated, and that we Germans lean towards that, yet it is beyond question that the shallowness of national education, due in the first instance to Britain's school methods, is driving her fast into an inferior rank for science and industry to that occupied by other countries, more especially Germany and North America."

That

[1] It would be difficult to overstate the great kindness and courtesy shewn the Commissioner, not only in the United Kingdom, but in every country visited. This greatly facilitated the Commissioner's studies, which would have been greatly hampered without such courtesy.

That is a sharp criticism, but it is not meant as an affront; and be it observed that it is overmatched by many things said by our own countrymen in their strenuous attempt to impress the Imperial authorities with the unqualified gravity of the existing situation. [See Chap IV., secs. 1-7, pp. 15-24.] There is a note almost of despair in some of their comments. Thus the Special Technical Committee of the London County Council says in its report (1902) :—

" *If it be asserted that England has fallen so far behind in the application of science to industry that it is useless to expend large sums of money in an attempt to regain a position which has been irrevocably lost,* we would reply that there is no finality in any industry; that all industries, if they are to survive, must become scientific industries; and that if machinery is set in motion by which new knowledge is created, old industries will be developed and new industries will arise. If it is urged that no decisive step should be taken to place the machinery for training post-graduate students in technological research on a satisfactory basis until prolonged inquiries have been carried out in Germany, Switzerland, and the United States, to ascertain the latest developments of technical education in those countries, we would reply that there have already been sufficient inquiries, and that *delay is dangerous. The cause of the want of vitality in our scientific industries is not far to seek; it is due to defects in secondary education,* and the lack of adequate provision for training in research. If secondary education can be more widely extended, if general and scientific education, both in secondary schools and schools of University standing, can be made more thorough, and if further opportunities can be provided to enable post-graduate and advanced students to obtain adequate training in technological research, there is no reason to fear for the future prosperity of our scientific industries."[1]

In the judgment of the Commissioner the truth is proclaimed in these passages, and Mr. Barraclough, of the Sydney University, is right when he says, "in the matter of engineering, technical progress, and industrial training, we are distinctly falling back,"[2] that is, of course, in comparison with other peoples. Hence it is clear that, in the words of the English Committee's report, we must change all this, "or submit to national decay."

2. *Some of the conspicuous defects of our System of Technical Education—Administrative defect.*—The first defect that may be referred to is one concerning the administrative scheme. Placed under the control of the officers of a Primary System of Education, which not only failed to satisfactorily respond to the World's progress in education, but even deteriorated in organic character, it is not remarkable that the technical educational system also failed to reach what its advocates had hoped for it.

For a system to give normal results, it must be under proper guidance, and technical education can no more succeed, under the control of a primary system of education, than could a University. The whole intellectual atmosphere, the professional sentiments, instincts and temper, the outlook upon men and the world, etc., is characteristically different, and necessarily so, for each great branch of education,[3] and for this reason each ought to be independent of the personal and other influences at least those *below* it. Excepting this country, the practice of the educated world is uniform in this respect. The question here referred to will, however, be dealt with later, and independently. The point to be noticed now is that the development of technical education took place under the controlling influence of primary instruction, and did not respond to what its machinery might have led one to expect. This is the most conspicuous administrative defect, and one which it will be necessary to remedy, if technical education is to progress satisfactorily.

3. *Indifferent Preparation for Organised Courses.*—The second conspicuous defect, one greatly affecting especially the higher planes of technical education, is the absence of any sufficient demand for proper preparation for the various organised courses. A student will, for example, present himself at the physics classes, who does not understand the transposition of a term from one side of any algebraic equation to the other,[4] or who has no adequate range of geometrical conceptions.[5] This absence of insistence upon proper educational preparation for definite

[1] "England and the English," p. 257. London, 1904.
[2] See this Summary, II, § 6.
[3] This ought not to be misunderstood. It contains no reflection upon the nature of the undoubted difference which exists. This difference arises from the set of facts and thoughts which are habitually present to the mind, and is what gives a characteristic appearance to each professional class.
[4] This statement is not overdrawn; how such ignorance limits the teaching can be better imagined than described.
[5] This statement applies even to some of the students attending physics lectures at the university.

definite courses is an evidence of our educational slovenliness, a slovenliness born of the absence of proper educational organisation throughout the community. There is no way of remedying this defect except by establishing what—leaving this State again out of consideration—is almost universal, viz., proper preparatory classes.

Such preparatory classes are the more necessary, because of the limitations of our primary system. Had we a good system, with a properly-trained teaching staff, and normally-equipped schools, the requisite foundation for technical education, not only in knowledge, but also in good mental habit, would have already been laid. The scientific tincture of mind is an essential for technical instruction, and though for the lower grades the depth of knowledge demanded is trivial, yet it is important that its range should be adequate, and that, so far as it goes, it should be thorough.[1]

With a professionally-trained teaching staff in our primary schools, less weight would be attached to memorising facts or to merely empirical processes, as for example in arithmetic; and more to sound mental training or the development of the thinking faculty. As a consequence, students would enter the technical colleges at least with a definite preparation, and one which could be either relied upon, or, if insufficient, supplemented in any required degree.

It is hardly necessary to remark that a *syllabus* does not constitute a course; it is a *pretence* if the student be not qualified to enter upon it, or the instructor qualified to teach as it directs. Hence in any sound educational system proper preparation must be always insisted upon.

4. *Defects in the Practical Instruction.*—The third conspicuous defect is betrayed by the indifferent character of the practical instruction. The burden of the complaints—not always quite just, perhaps, of this more anon—against the technical colleges of the State is that the instruction is not practical enough; that the régime is such that it does not produce good tradesmen; and it is alleged that, as a matter of fact, the number of skilled workmen in the State is diminishing instead of increasing.

The practical instruction, in many cases, is undoubtedly very amateurish, dilettanteish. The work usually has no definite objective. The plumbing, for example, consists simply of a series of exercises constituting mere samples of work, doomed to the melting-pot. The fitting and turning is subject to much the same criticism. Metal is turned, and returned, and ordinarily consigned to the foundry or waste-heap. The forge-work, while good, consists again mainly of a series of exercises constituting, ordinarily, samples of little practical value. The carpentry is too much of the nature of toying with the subject; it is good in its way, but is not of that practical character which would assure the student immediate success as a tradesman when he leaves the College. The lavatory and similar services and equipment of the College leave much to be desired, but there has been no systematic attempt, until quite recently, to alter this state of things.[2] In other countries, with such engineering equipment as the College possessed, a very considerable number of lathes for both wood and metal turning, drilling and planing machines, etc., might well have been constructed for the necessary extensions of technical education.

No country in the world can afford to be wasteful of its industrial effort, even in the training of students, let alone a young country in the initial stages of development, actually in the throes of endeavouring to create the material wealth it requires for a normal rate of growth in population and strength.

Had the organisation of the Technical College of Sydney in the Engineering and Wood-working departments been comparable to what it is in any country of Continental Europe, visited by the Commissioner, or in America, the material manufactured in the College would have powerfully assisted the development of technical education over a wider area, or it might have been devoted even to reduction of students' fees if that were deemed desirable. The

---

[1] Owing to the absence of proper scientific education for the teaching staff of the primary schools, some curious mistakes are occasionally heard, *e.g.*, that saltpetre = rocksalt! It is to this sort of thing that the substitution of an etymological guess for scientific knowledge leads.

[2] It ought to be stated that attempts are being made to enable the students to undertake practical work for definite objects, so as to bring about the necessary change.

The results in industrial education achieved in such schools as Mr. Booker T. Washington's at Tuskegee, Alabama, with negroes, put our results and our whole scheme of technical education to shame. [See Chap. XX, secs. 1–46, pp. 223–235.] So also do those achieved in the multitude of schools for theoretical and practical industrial education throughout Europe.

5. *Indifferent Educative Character of Instruction.*—A fourth defect is the absence of sufficient care that the work shall be always educatively organised. Ladies, for example, in what is known as wood-carving, often have their designs drafted on the wood by the instructor, or transfer a design to the wood and cut according to that, instead of doing the designing themselves. Results so obtained are misleading, and are practically worthless from the standpoint of industrial efficiency. They may well be left to private tuition. They are not industrial efforts, nor do they constitute industrial training; they are little more than pastime exercises. A somewhat similar criticism applies to the work that might be included in ceramics.

Such training produces mere copyists; a certain amount of very ordinary manual dexterity, but not industrial artists.

6. *Limited Conceptions of Technology.*—A fifth defect is what may be called technological narrowness. This may be easily illustrated. In a Hungarian school for joiners, cabinet-makers, turners, wood engravers, etc., for example, the technology of wood is thoroughly treated. The general morphology of the tree; the reciprocal relations of its constituent parts; its histology; the chemical composition of various parts; the qualities of wood from the standpoint of technology; the cutting of the tree; the seasoning, drying, and impregnation of the timber; the action of chemical agents; staining; treatment by varnishing, polishing, and so on; all these are brought under review. [Chap. XII, sec. 27, pp. 139–140.] Thus the young workman looks out on the materials of his life-work with more intelligent eyes.

A different type of similar wide culture may be seen in connection with the work of the *Ecole Estienne*, of Paris, in which the history of art, of books, and of printing and publishing are very finely treated. [Chap. IX, sec. 14, pp. 83–4.]

Still another illustration is to be found in the whole association of the subjects taken in a course.

Every worker in the fitting and turning shop, for example, will have learnt something of the effect of different substances in iron, or steel, carbon, nickel, tungsten, phosphorus, silicon, etc.; he will know something of metallurgy and the technology of iron and steel, etc.

6. *Limitations in the Pædagogy of Technics.*—A sixth defect is very much more difficult to define: it is what may be called the low apperceptive value of much of the instruction. But few of the instructors are educationists, or are informed in such subjects as every educationist should study. Hence their personal influence over the pupil, the stimulus of their instruction and influence, the lucidity of their technological ideas, and their capacity to enlarge the outlook of the workmen whom they train is very limited as compared with their European confreres.

This type of excellence in an instructor may seem a very trivial matter to the superficial critic; in reality it is very far-reaching in its consequences, and profoundly affects the level of workmen's intelligence.

Every well-informed educational investigator will find the same defects which have been mentioned above, and they must be very seriously attended to if our workmen are to be raised to the level of the men now being trained in Europe.

8. *Defects in Equipments.*—Excepting the Technological Museum associated with the College, which is well organised, and which reflects great credit upon those who have built it up, the technical equipments of the Technical College are not to be compared with those of comparable institutions in Europe. The buildings are wretchedly designed for their purpose, though of good external appearance. The Libraries are small, that of the College numbering only 4,750, £100 per annum being allowed for additions; and that of the Museum 6,000, £60 being allowed for annual additions.

The

The country colleges have small associated museums, which are only fairly well developed.

The laboratories are poorly arranged, and by no means well equipped; they need to be considerably enlarged. Organic chemistry is indifferently represented, but has been developed to a fair extent in connection with the valuable research work of the Technological Museum.

The Sydney College possesses a 100-ton testing machine, but although practical tests of various materials have been carried out from time to time, scientific researches on the elastic or other properties of materials form no part of the courses in engineering.

9. *Assistance to Education by State Railways.*—America, Germany, and the advanced countries of Europe recognise that no question is of more fundamental importance than the educational system, the system which operates upon, and even determines, the development of national intelligence, character, general efficiency, commercial skill, and industrial power. Admitting this in some measure in the State policy, it has been the custom to permit State Public School and State High School pupils to travel free,[1] and to allow the pupils of the technical college to travel at half-fares.

As a matter of economic policy it is obvious that a State system of railways may well be utilised for *any* purpose which not only favourably affects the future development of the State, but is an essential of progress. If, further, anything profoundly affecting the State's welfare does not also materially affect the existing cost to the State of its railway system, there can be no valid objection to such utilisation. Technical education will ultimately establish a population on the land by enhancing the industrial and technical competency of the people; in fact, all good education is a factor of the first order of importance in this respect.

It follows from this that in any consideration of the *extension* of technical education, the use made of the railway system in a developing State may very properly come up for consideration. It has already been pointed out that the extent to which such education is afforded falls so short of the requirements of a school population of 250,000, that being strikingly disclosed by so small an annual vote as £30,000.

If pupils and teachers travelling either to receive or give technical instruction were permitted to travel free, no serious loss would be suffered by the Railway Commissioners, *considered even as private owners.* The dearth of competent instructors is very great, and to give technical instruction they have to travel from centre to centre—that is the condition of things prevailing in the State.

That the Railway Department would not be subjected to other than negligible loss by doing what is suggested, is evident on giving the matter consideration. If technical education be *not* established, no fares can be lost that would otherwise swell the receipts of the Railway Commissioners, for there will be no travelling of either students or teachers, for it will be difficult to promote technical education with a scattered population, owing, as pointed out, to the serious difficulty of getting the services of competent teachers.

On the other hand, if technical education *be* widely established, it will undoubtedly bear fruit in the form of a more industrially active life in the State, so that remunerative railway traffic will grow in virtue of any proposed extension of educational effort, an observation which applies, of course, to every branch of education, as well as to technical.

Assuming that the policy of the authorities of any new country, in promoting its development, will be to utilise the railway system as much as possible, and bearing in mind that the Railway Department, as things stand at present, can without difficulty carry the extra passengers involved in the suggestion, it will be recognised that the *actual expense to the State* may be treated as negligible, since the increased load is so trifling as hardly to affect the question of actual cost, that is to the State. On the other hand, however, the benefits even to the Railway Department itself, ultimately arising from the advance of education, will be very great.

From

[1] The question of the continuance of this privilege was recently raised by the Railway Commissioners, but fortunately for education, and for the future of this State, its continuance was decided.

From the standpoint of State policy, therefore, the question for consideration is the following, viz.:—"Will this actual expense to the State of carrying students and teachers free be compensated by the improvement in the material status of the population?" If the form of education is that really needed by the people, the answer must be "Yes," and in the question is so momentous that the mere matter of book-keeping, as between different State departments, by which one may be enabled to swell its income by the apparent enlargement of the expenditure of another, may be regarded as almost irrelevant. As pointed out, it is only the *actual* cost which need be considered.

As soon as the unqualified importance of education is grasped the principle, already admitted in the practice of the State, would indicate that free travelling for educational purposes should be allowed for students and teachers under such well-defined conditions as will ensure the proper use being made of the proposed railway concession. On the State trams all under 18 years of age also travel at half-fare.[1]

10. *Conclusions.*—It must not be inferred from the above outline of the defects in the scheme of technical education in New South Wales that it is implied that no excellent work is done in the technical colleges. Much of the adverse criticism which appears publicly is by no means disinterested. And as in our very inferior system of primary education there has nevertheless been excellent education, so also in our very imperfect scheme of technical education there are various features that any educationist would regard with satisfaction. As in primary education, so in technical, these excellencies are not because of, but in spite of the organisation.[2]

11. *Recommendations.*—The following recommendations are indicated as the result of the whole course of the investigation concerning the organisation and subject-matter of technical education throughout Europe and America, viz.:—

1. A sharper distinction should be drawn between lower professional courses and trade courses. (Analogous to the difference between a *Technikum* and a *Gewerbe* or *Industrie-Schule.*)
2. The curricula of all the organised courses should be carefully remodelled, so as to ensure proper correlation of the various elements of instruction.
3. The entrance conditions for the several courses should be more clearly defined, and in the near future should be rigorously insisted upon.
4. Special classes giving the necessary elementary instruction should be instituted to prepare properly students for the various courses.
5. General manual training should be provided for the preparatory classes.
6. The preparatory classes should give elementary instruction in the national sciences.
7. The practical instruction should in all cases be, as far as possible, carefully co-ordinated with the theoretical instruction.
8. The practical instruction should be thorough, aim at definite and useful work, and should be completely reorganised to that end.
9. Arrangements should be made so that students may work under conditions as nearly as possible corresponding to those actually obtaining in ordinary trade practice.
10. A larger number of organised day classes should be arranged, and so constituted as to form schools of the type of the "Apprentice Schools."
11. In every department a scheme of useful work should be at once arranged, so that students may get the best form of practical education.

12.

[1] Technical College students under 18 attending full day-classes travel at quarter-season ticket rates. For vacations, students not in any occupation or receipt of wages are allowed to travel at half single-fare for the double journey, etc., etc.

[2] No matter how defective an organisation, individuals will rise above it; and no matter how excellent, they will fall below it.

12. Among other things, the students should manufacture machines and apparatus both for the Sydney college itself and for the country colleges.

13. The industrial efforts of the students should not be wasted as heretofore, and the instructors should be required to draft out and design suitable work for students to engage in. The drafting out of such work will itself be educative.

14. The scientific apparatus needs putting in order and extending.

15. A fine-mechanism section should be equipped, and the course arranged for it.

16. Courses of instruction for the leather trades, and particularly for tanning and leather-dyeing, should be instituted.

17. Bootmaking classes should be instituted in a properly-equipped school.

18. Connected with technical education, and under the direct control of the Director thereof, Evening Continuation Schools should be established, or extended, giving instruction in such subjects as Manual Training, pure and applied mathematics, languages, elementary natural science, freehand, linear, and technical forms of drawing, foreign languages, and other similar subjects of importance in technical education.

19. Some of the Instructors should give more undivided attention to their courses, and to the acquisition of some knowledge of general educational theory.

20. A scheme should be arranged so that future teachers will be more highly qualified, both theoretically, practically, and in educational theory and practice.

21. Technical Education should be much more efficiently organised in various parts of the State.

22. The travelling of Technical Instructors and students for the purpose of giving or receiving instruction, should be facilitated as much as possible on the railways, as suggested hereunder, viz.:—

    (a) Free travelling on the State Railways should be provided for all Teachers of the Public Instruction Department (Primary and Secondary Education Branches) for the purpose of attending regular instruction in the Technical Colleges and classes and the University;

    (b) Free travelling on the State Railways should be provided for all Students attending the Technical Colleges or Technical Classes held throughout the State;

    (c) Free travelling on the State Railways should be provided for all Teachers in the Technical Colleges and Classes for the purpose of giving instruction in technical subjects.

In each case the concession should be granted only for the express purpose of attendance at or giving instruction in technical subjects, and for no other purpose.

XXVII.

ADMINISTRATIVE ORGANISATION OF PUBLIC EDUCATION IN NEW SOUTH WALES.

[G. H. KNIBBS.]

1. *Introductory.*—As is well recognised in all parts of the civilised world, the *scheme of administrative organisation* of public education is of profound importance, and its consequences are far-reaching; and in the inception of a new régime in this State it is desirable to at once get rid of every existing condition which tends to hamper in any way the *efficiency of public education.* The existing organisation is one that cannot satisfactorily continue; since it is not consistent with efficiency, as will be shewn hereinafter. It is substantially an attempt to control the higher forms of education by the lower.

Every great branch of public instruction should be immediately under an officer who may appropriately be called the *Director-General* of his particular branch. He should be responsible to the Minister alone, and next under the Minister, should be the supreme head of the department under him. It is *not* essential that all branches of education should be under the one Minister, nor is it in any way necessary that any one Minister should have only one departmental head under him.[1] It is unnecessary to state that there is ample precedent for what is affirmed, and these propositions merely conform to the larger experiences of other parts of the world.

2. *Present Organisation of Public Instruction, the University.*—The present organisation of public instruction, as it exists in this State, is *sui generis*, though it has some features of similarity with British organisation.

One important branch of public education is under the "Minister of Public Instruction," another under the "Minister for Mines and Agriculture."

At the head of the highest form of organised public education in the State, is the "Chancellor" of the University, who, with his colleague, the "Vice-Chancellor," is elected by the "Senate" from the members of its own body. The former is President of the Senate, which consists of sixteen elected "Fellows," elected for life,[2] and not more than six, nor less than three, professors of the University in such branches of learning as the Senate may from time to time select.

As governing body of the University, the Senate is absolute in its power, excepting in so far as that power is delimited by the Act of Incorporation, and by contracts entered into with the teaching staff and others.

So far as material equipment is concerned the University was created by the gift of land and buildings and equipment by the State; it has a statutory endowment of £10,000 per annum, and has received a number of bequests, viz., the Challis bequest of £250,000; the Sir Peter Nicol Russell bequest of £100,000; and the Thomas Fisher Library bequest of £30,000.

3.

[1] For this there is precedent even in this State, as in the Department of Labour and Industry; and again in the Public Librarian's Department.

[2] The wisdom of so constituting the Senate that its members are elected for life is much debated, some holding that election for a period of five years would secure more devotion to the University's interests. The electing body consists of the Fellows of the Senate for the time being, the professors and public teachers, and examiners of the University, principals of incorporated colleges within the University, all doctors and masters, and also bachelors of three years standing, and "Superior officers" of the University.

3. *Has the University sufficient financial support?*—That a young country like Australia should possess an institution like the University of Sydney is no doubt matter for felicitation, but it is sometimes forgotten that after all our expenditure for higher education is extremely small—even startlingly small—when compared with that of Germany. Let us compare, say, Württemberg, in Germany, which has a population similar to New South Wales, with our own State.

Comparison of Expenditure, Higher Education.

		Württemberg.	New South Wales.
Population ...		2,000,000	1,500,000
Area, in square miles		7,530	311,000
Revenue ...		£4,500,000	£11,500,000
Grant for higher education—			
State University	£55,000		
Technical University ...	20,000		
Agricultural and Veterinary High School	15,500		
Gymnasien, etc.[1]	35,000	£	£
		125,500	13,500
Technical Schools ...		42,700	39,600
Training Schools ...		24,000	5,094

That these figures are not exceptional is confirmed by the fact that the average extraordinary expenditures for three Prussian technical universities for the decade 1890–1900 was about £18,700 each per annum, and the annual State subsidy for a new technical university at Danzig,[2] a town of less than 150,000 inhabitants, is to be £18,500.

It will at once be seen that the present financial possibilities in the administration of higher education in this State are very limited, for, as a people, we do not as yet truly believe in education, and the income and equipment of the University are very limited from the standpoint of modern European Universities, and quite inadequate to meet the normal wants of a school population of about 250,000.[3] The State University cannot work on the plane of the European University for this reason alone, and because of the absence of any satisfactory system of secondary education, it is still further handicapped by having to undertake so much work which is merely secondary education.

Secondary Education.—There is at present really no organisation of secondary education; in fact, up to the present time, the advanced type of secondary school does not exist in this State; that is to say, there are no schools of the academic status of the Classical or the "Real" Gymnasium, or the Oberrealschule of Germany, or the French Lycée, and so on.

With the exception of four schools under the Department of Public Instruction known as "High Schools," all the Secondary Schools are either denominational or private. None of the private schools are under the control of, or responsible to the Government, and only one of them receives an annual subsidy (the Sydney Grammar School).

Compared with European schools, those which have been called secondary here are more of the nature of higher primary schools.

Seeing that private schools are wholly irresponsible, except in regard to an ill-defined public opinion; that anyone can open a school, and anyone serve as a teacher, that the State insists upon nothing in regard to curriculum, staff, equipment, or organisation; it is a little difficult to give a general account of what does not exist, viz., the administrative scheme of secondary education in New South Wales.[4]

5.

[1] Not including the State contribution for teachers' salaries. All these schools are academically comparable to British Universities.

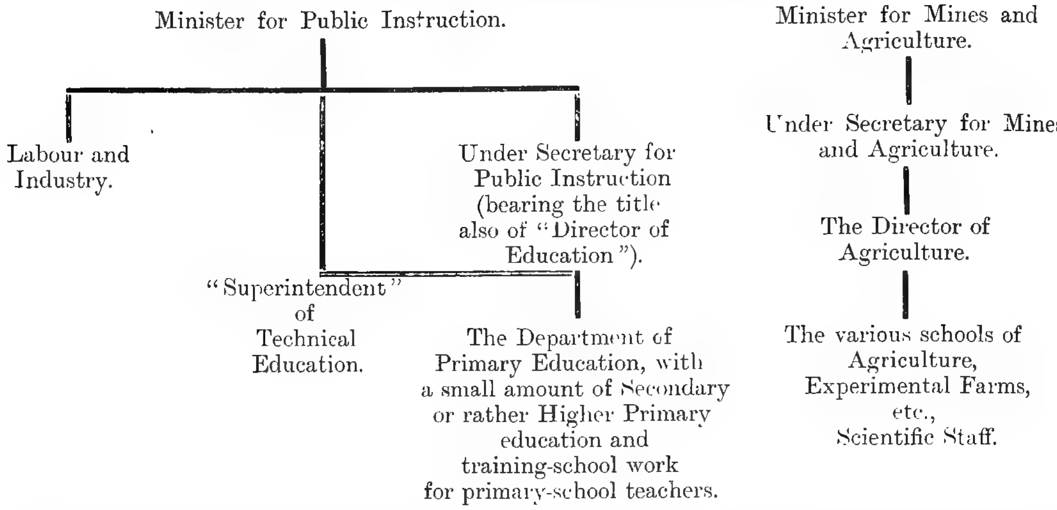
[2] The Danzig Technical High School is to cost, with equipment of chemical laboratory, £222,000.

[3] This would probably become very evident if the restrictive compulsory Latin were removed. This would tend to make the University far more popular, cultural, and useful, but it would no doubt find itself quite unable to provide for those who would desire to attend.

[4] Owing to this absence of organisation, the University has practically to devote much of its time to supplementary secondary education, which the matriculate should have had before entering.

5. *The Organisation of other branches of Education.*—The remaining branches of education, Agricultural and Technical, and Industrial and Primary, are not organised under one department. Agricultural education is afforded under both the Technical Branch of the Department of Public Instruction and the Department of Agriculture: Technical and Industrial education under the former only. Both branches of agricultural education give practical illustrations in agriculture, but that under the Department is organised so as to include practical farming and practical zootechnics. The head of the Agricultural Department is known as the "*Director of Agriculture.*" The existing organisation is therefore:—

Educational Organisation in New South Wales.



For the purposes of supervision and administration, senior and junior inspectors are appointed, the head of these being known as the "Chief Inspector."

The organisation was obviously very ill-considered, for formerly the "Superintendent of Technical Education" was actually the subordinate of the Chief Inspector of the Department of Public Instruction—that is, of one who was absolutely without experience as a technologist! As already pointed out, such an arrangement is anomalous, and quite incompatible with efficiency.

Under the present administrative arrangement the so-called "Superintendent of Technical Education" is, for the purposes of record, an officer of the Department of Primary Public Instruction; for consultative purposes he has direct access to the Minister. Though the latter element slightly alleviates the situation, such an arrangement—as it will be evident to everyone competent to form a judgment—is essentially bad from the administrative point of view, a point to which further reference will be made.[1]

The titles of the officers also are ill-considered and misleading. The Under Secretary of Public Instruction is, *de facto*, "Director-General of Primary and Higher Primary Education." That the title without qualification is too all-inclusive appears from the fact, for example, that he is not Director of University Education.

The so-called Superintendent of Technical Education is, *de facto*, "Director-General of Technical and Industrial Education," excepting, however, such technical forms as professional education in the University, and such agricultural education as is given under the Department of Mines and Agriculture. For, excepting the professional schools in the University, the actually existing technical forms of education are schools giving some form of commercial education; and also the Technical and Agricultural Colleges and Classes. The Commercial Schools are wholly private, and, in common with most private schools, are not responsible to any constituted authority; that is to say, they are "private adventure" schools pure and simple, and, so far, we have not treated education as a matter in regard to which the State is under the obligation of defending its subjects from the incompetency, or it may be even the cupidity, of persons who establish schools as commercial ventures.[2]

6.

---

[1] As to the personal aspects of the question, it may be said that the existing state of things is made tolerable by the very cordial personal relations between the Under Secretary and "Superintendent." It is none the less administratively bad, and wrong in principle.

[2] It is not meant that private schools are necessarily bad, but that the public at present is in no way safe-guarded by the State against the setting-up of indifferent private schools.

6. *The Principles of the Administrative Organisation of Education.*—Primary Education is a branch of education in itself, demanding the supreme attention of one directing intelligence. Hence it should be under a "*Director-General of Primary Education,*" who, for political reasons, must be directly responsible to the Minister of Public Instruction. When in the future Secondary Education takes such organised form as its importance demands, it will be necessary to appoint, also, a "*Director-General of Secondary Education,*" and at present the two offices might be resident in the one professional head, *i.e.*, the "*Director-General of Primary and Secondary Education.*" But ultimately each office must be independent.

The officer directing Technical and Industrial Education should also have the title defining his proper function, viz., "*Director-General of Technical Education.*" He should be directly under the Minister for Public Instruction, and his administrative functions should be independent, and be carried out directly under the Minister.

There is precedent for this, even under the present defective scheme of organisation of public departments which usually makes the Under Secretary the officer in direct personal touch with the Minister, instead of placing the professionally and technically qualified officer in that position.[1]

The Public Librarian was formerly, and the officer in charge of the Department of Labour and Industry still is, directly under the Minister for Public Instruction, so that there is no valid administrative reason why the Department of Technical Education should not be also placed directly under the Minister.

Just as Primary Education must necessarily command the supreme attention of a very able man—and it may be said that the development and oversight of a department of primary instruction will give scope for even more ability than anyone can hope to possess—so also will Technical Education make the same supreme demand on a directing mind.

In this connection it should be borne in mind that, in the past, the degree of attention given to the educational problem, and the ability with which it was attacked, judged at least by the results, left much to be desired; and in the future the professional and general resources of the most able Director will be severely taxed to make good the leeway of the educational ship, or to warrant any hope of our ever overtaking the systems of other parts of the world.

If a Director of Primary Education interfered with the work of a Director of Technical Education it could lead only to difficulty, disorganisation, and confusion of the technical system, and it would also be ridiculous for a Director of Technical Education to intrude upon the work and functions of a Director of Primary Education. The two functions are separate and distinct, notwithstanding that there are points of contact, in regard to which there must be some scheme of occasional review—of which more anon.

In an earlier part of this summarised report it has been pointed out that the whole educational atmosphere for each branch of education is different. The tincture of mind is determined by the circumstances of daily association. The type of special knowledge acquired is different. Each educationist will become a specialist in his proper field, but not in the other.

7. *The Normal Scheme of Administrative Arrangement.*—Thus the normal and only satisfactory administrative arrangement is that the director of each branch of education be the supreme officer—under, of course, the Minister—and be free to devote his time to the professional and higher questions of his office, having a secretary or chief clerk under him to ensure a smooth working of the mere administrative machinery. This last is obviously only a humble means to an important end, viz., public education.

For a Director-General of Primary Education to attempt to review the submissions of any competent Director-General of Technical Education is absurd on the face of it; and the latter, if competent, would certainly not think of reviewing the submissions of the former supposed competent, and restricted to his proper field.

That the under secretary or chief clerk should be the subordinate of the director or highest professional officer, must necessarily commend itself to anyone who

[1] Circumstances are forcing a change, and to get over the difficulty professionally-trained and technically-competent officers are being made under secretaries.

who will seriously weigh the pros and cons of the question, or refer to successful administrations for guidance. This is the arrangement in Victoria, New Zealand, etc., and the Commonwealth administrative machinery happily follows the method here advocated.

A further reason for a complete departure from the arrangement formerly existing is that the change would lead to far greater economy.

The vote for Technical Education is very properly independent of that for Primary and Secondary Education, and to keep the whole administration distinct will not only ensure that the administrative detail of Technical Education shall be thoroughly harmonised with its proper spirit and genius, it will also save a great deal of double recording, irritation, and waste of effort.

It is unqualifiedly essential that the Director-General of Technical Education shall have a complete record and analysis of the whole administrative machinery of the branch of public instruction under his immediate care, of the units of its personnel and their training, their personal and professional character, and so on. The whole organisation is his field, and he must have complete and thoroughly analysed records, to say nothing of his being able to impress his own personality upon the system.

Any competent officer directing technical education must necessarily be harassed by the delays and waste of valuable time arising from the multitudinous minuting of papers, which, at present, is quite characteristic of even the most insignificant document.

Administration is not an end in itself, but a means to an end; and the loss of time and energy, the fret and worry of every piece of unnecessary and objectless red-tapeism, should, in the public interest, and in the interests of the efficiency of education—which is the same thing—be eliminated from the administration scheme of each branch of public instruction. We have certainly forgotten sometimes, that administration is bad unless the end for which it exists is facilitated by it.

8. *Educational Councils.*—In the Report on Secondary Education [Chap. XIII, sec. 3, pp. 142–3] the Constitution of a Higher Advisory Council for Secondary Education (“*Conseil supérieur de l'instruction publique*”) was given. It consisted of the Minister, 46 representatives of higher, 6 of primary, and 4 of private education.

Something similar is needed here. There should be one *Council for Primary Education,* with a marked predominance of officers of the Primary Instruction Department, and experts in Primary Education, or persons really deeply interested therein, but the University and Technical Education Branch should be represented thereupon. For Technical Education there should be a different Council, the predominance should be in the representation of technical teachers, technologists generally, and persons who are students of science, but Primary Education and the University should also be represented.

Such Advisory Councils, if well constituted, could greatly assist educational progress. If their constitution was ill-advised as regards personnel, they would be probably worse than useless.

Such councils could review the whole trend of educational progress and assist in keeping the great movements of public education in close sympathy and could secure their harmonious development.

9. *Recommendations.*—It is recommended that:—

1. The officer directing Technical Education receive the title “Director-General of Technical Education,” and be made administratively independent, as indicated in sections 6 and 7 above.
2. That a Technical Advisory Council be appointed consisting of fifteen members eminent in some branch of technology, or science, or otherwise interested in Technical Education; together with three members nominated by the Public Instruction Department.
3. That a Primary Advisory Council be constituted on an analogous principle, and on the lines suggested in sections 6 and 7 above.

XXVIII.

XXVIII.

INSTITUTIONS OF IMPORTANCE TO PUBLIC EDUCATION.

[G. H. KNIBBS.

1. General.
2. Libraries.
3. Special Scientific Libraries.
4. Museums.
5. Research Laboratories.
6. Recommendations.

1. *General.*—There are a number of institutions of great importance or essential to public education, some of which specially deserve mention—because, although of high educative value, they are unduly weak at the present time, for example, libraries, museums, etc. It is natural that young countries should be characteristically indifferent in respect of such institutions; they take time to build up. It is, therefore, rather the *rate* of progress than the absolute size of the institutions that should be taken into account.

2. *Libraries.*—The American people, who may be regarded as having of recent years been deeply stirred as to the true significance of the whole matter of education, are rapidly and very liberally equipping their public libraries, particularly those belonging to their more important educational institutions. In consequence of this, it is becoming extremely difficult to make libraries complete, especially scientific libraries, for these should contain the whole series of every important scientific publication throughout the world. Since the Americans are foresighted in matters of public concern, they have ordered in advance all the scientific series of known reputation for a large number of libraries which they are creating. It is becoming, therefore, increasingly difficult to fill up any gap in these series of scientific publications.

No better indication could be given of the value of libraries.

The following is a list of the principal libraries of the Metropolis:—

Particulars of Libraries.

Name of Library.	Ascertained or estimated number of books in Library.	Amount allowed for additions per annum.
The University Library...	68,000	No. 8,000[1]
Sydney Technical College Library	4,750	£100
The Royal Society's Library	19,000	Exchanges + £60
The Linnean Society's Library...	8,500	Exchanges
State Public Library	167,700	2,020
State Parliament House Library	46,400	590
The Australian Museum's Library	12,000	440
The Technological Museum Library	6,000	60
State Botanic Gardens' Library	3,650	55
State Public Works Department's Library	2,000	215
Government Observatory's Library	2,500	40
State Mines Department's Library	6,500	20
State Department of Agriculture Library	2,350	40
Attorney-General's Department Library	9,000	220
The Supreme Court Library	5,000	200
The Equity Court Library[2]	2,750	70
The District Court Library	1,850	80
The Prothonotary's Library	500	20
The Registrar in Bankruptcy's Library	750	20
Country Court-houses' Libraries	(?)	850
Municipal Libraries[3]	(?)	....
School of Arts' Libraries	(?)	....
Total	369,200	

[1] Number of books, including "parts." The number of "volumes" would be very much less.
[2] There are actually two.
[3] In twenty years there have been grants to sixty-two.

Comparing

Comparing the condition of things in Europe with those obtaining in the State, it may be said that up to the present time we have no adequate Australian conviction as to the need of libraries.

In ten Gymnasiums, Lyceums, etc., in Hungary, there are libraries of from 16,000 to 68,000 volumes each, 331,000 volumes in all.[1] That is for ten secondary schools alone. In the whole of the Hungarian secondary schools there are 1,220,000 scientific works, 139,000 volumes of reviews, 409,000 of miscellaneous works; in all, 1,768,000 works, more than five times the number of works in our important metropolitan libraries.

The libraries for pupils' ordinary use in Hungarian secondary schools contain 58,000 text-books and classic works, and 322,000 volumes for general reading.

Comparing the state of things here with those in America, and particularly with those in Europe, it is evident that we need altogether richer libraries. In Germany[2] people spend more on books than we do, and are in this way altogether better informed.

3. *Special Scientific Libraries.*—Among the scientific libraries of great importance are those of the Royal Society, the Australian Museum, the Linnean Society, the Library of the Mines Department, and that of the Technological Museum. Most of these are largely supplementary of one another, and all existing duplication is a distinct advantage.

Among them the library of the Royal Society is perhaps the finest; and as education developes in this State, in a way comparable to the development in Europe or America, the importance of the library to the student will be overwhelmingly manifest.[3]

This Society has spent over £5,400 in the purchase of books, and has published original researches, exchanging with over 430 kindred societies, scattered over all parts of the world.

It has for many years been in receipt of annual subsidy (pound for pound), limited to £500; this, however, has been recently reduced to £250, which will greatly hamper the public usefulness of the Society, and prevent it from continuing to discharge a valuable work for the future of Australia.[4] This may appear a small matter to the superficial critic, but it is one which must be deplored by every person who recognises the character of the Society's work and its immense importance to the scientific future, not only of the State, but even of Australia.

Where societies of public-spirited men, the sincerity of whose views is testified by the liberality of their financial support, are building up institutions of this character, it is to be deeply regretted that their work should be insufficiently appreciated and inadequately assisted,[5] and that the discharging of a high public educational duty, by appeal to private liberality, should be crippled by any change of attitude on part of the State authorities.

What is said of the Royal Society applies in some measure also to other scientific societies. The public benefit of their work can be greatly assisted by State aid, and, bearing in mind the influence of education, it would be a public disaster, and a seriously retrogressive step, educationally, if their work be treated unsympathetically. The poverty of the total library equipment of our State accentuates the need for encouraging every private effort to build up disinterested educational institutions, not merely of great value, but essential to our future well-being.

4.

---

[1] Twice as many books as in our public library, or approximately the same number of books as exist in all our metropolitan libraries combined, omitting that of the Sydney School of Arts.

[2] To give a definite idea of the library equipments of German *Gymnasien*, etc., the Commissioner gave the Report of a year's purchase of books in such an institution; *vide* Rept. Secondary Educ. [Chap. XXIX, secs. 7, 8, pp. 348-352.]

[3] It was publicly stated by Prof. R. Threlfall, M.A., F.R.S., etc., sometime Professor of Physics at the Sydney University, that the assistance afforded him by this Library was indispensable to the discharge of his University work when he came to the State.

[4] It is quite impossible to understand the essential character of the Society's work, and fail to see that this is not a sound economy.

[5] Members of the Royal Society pay £2 2s. per year subscription, in order to make possible the discussion and publication of original scientific papers. Sometimes authors assist in the expense of publishing their papers to amounts ranging up to £40 for a single paper.

4. *Museums.*—The matter of museums has been referred to in the three reports of the Commissioners; that is, in connection with primary, secondary, and technical education.

If we are to progress educationally, it will be necessary to provoke every primary school to build up a school-museum.[1] Those of secondary schools will have to emulate the very fine natural history and other museums which are to be found in every secondary school in Continental Europe; and, further, every technical college will have to possess both a scientific and a technological museum.

Technical schools must have a foundation of instruction in, at least, elementary natural science, and they must, of course, represent technology.

They should, therefore, possess the following, viz.:—

(*a*) A properly named and arranged zoological collection, representing (i) local animals; (ii) those important from the standpoint of systematic zoology; (iii) those important from the standpoint of commerce and industry.

(*b*) A botanical collection of similar character and arrangement; and, also,

(*c*) A similar geological and mineralogical collection.

(*d*) A collection illustrating local industries and articles of commerce.

All these are of an importance, which however popularly unappreciated, can hardly be overestimated, and the existing state of things is but evidence of our insular limitations.

It will be easy to invoke the interest of all educated people of scientific temperament, and of all who possess any measure of public spirit.

5. *Research Laboratories.*—Some excellent research is going on in the University; in the laboratories of some of the State departments; in the Australian and Technological Museums, etc.; but the whole is small compared with what would be undertaken in a Continental community of similar magnitude. This matter has been already referred to in the Summary; but it will bear repeating. We need much more liberal assistance in order to hope to reach such splendid results as are reached in Europe. *Research work keeps alive the highest form of educational effort*, and is an essential for scientific and technical progress.

6. *Recommendations.*—The following recommendations are made with a view of helping us to move towards the educational excellence of progressive countries in the other hemisphere:—

1. Small libraries and museums should be established in all the primary schools of the State.
2. The libraries and museums of the technical colleges would be greatly enlarged and made more representative. Efforts should be made to secure local sympathy and assistance.
3. The agricultural, industrial, and commercial sides should be carefully attended to in such enlargement.
4. Institutions such as the Royal Linnean and similar societies should receive every encouragement, and as liberal financial assistance as the State can possibly afford, to enable them not merely to continue, but also to extend their efforts as far as possible.[2]
5. Where "Schools of Arts" do not apply their subsidies in the true interests of education, they might well be withdrawn, with a view of securing greater educational advantage from the subsidy.

[1] The Department of Mines has done much valuable work in this direction, and the Technological Museum has made its contribution also.

[2] It should be remembered that the activities of such societies is the only ground for the liberal, indeed most generous, response in the way of exchanges. The original work in scientific societies secures magnificent donations from all parts of the world that would otherwise certainly never reach us; the humble measure of our return is never mentioned. We have great reason for gratitude, and it is a matter for regret that this is so little understood or appreciated.

XXIX.

INDUSTRIAL EDUCATION: TRADE SCHOOLS.

[J. W. TURNER.]

In inviting attention to the information the Commissioner has collected on the subject of Industrial Education, it is absolutely necessary for him to speak strongly, and without reserve, upon the more important phases of our administrative and political life. After considerable reflection, he finds that he cannot escape from making certain analogies, which must be stated in order that a proper appreciation of what other countries have done, and what we as a country have failed to do, may be understood.

In the older countries there is an intellectual concentration upon all forms of education that lead up to profitable work, and, although our young country has had very few facilities for this development, we cannot hold ourselves blameless in regard to the use we have made of our opportunities. It was a clear vision that led to the establishment of the Sydney Technical College. The idea of such work being of vital importance to the community originated in the minds of a few practical men, such as Mr. Norman Selfe and others, who in the early days constituted the Technical Board in this city.

The taste given to the community by this class of instruction created such a positive demand that more potential methods became imperative, and the present Technical College, which even as it stands would be a credit to any community, was brought into active existence. But the idea of so conducting our primary schools as to incorporate in their curriculum the beginnings of industrial education was very slow in coming into life. Much of what is rudimentary in technical education could long ago have been made part and parcel of the daily instruction in special classes attached to our public schools. This would have lightened the work of our Technical College, and would have enabled us to have reserved that institution as the University of this class of teaching. All these great developments, however, have to wait not only upon the enlightenment of those officials who are entrusted with the responsibility of such work, but upon the calibre of those who for the time being, representing the political power of the country, can exercise a veto over any proposal affecting the policy of education in this country.

The present Public Instruction Act, admirable in all its aims, was born in the throes of a great struggle, the keynote of which was that the State should have the responsibility for the education of its children as against any denominational body. By the placing of such an Act on the Statute Book the people gained a great and, the Commissioner trusts, a lasting advantage; but so severe was the battle that, from a political point of view, it was deemed inexpedient to alter the Act in any way, for fear that in the attempt to do so old wounds would be reopened and rancour revived. Thus it was that many important improvements had to be deferred. Safe and sound men have invariably been selected to control the destinies of this great department of the State, and, as a consequence, while at the present time we realise that we have innumerable improvements to effect, we also know that we have preserved to us an instrument in the shape of the Act which we are now free to temper afresh for keener work.

While not desirous of entering the debatable area of politics, the Commissioner finds it impossible to treat this question adequately without referring at some length to the great influence fiscalism as a political question has had upon the progress of this State. Where America and the great continental countries have worked solely for the development of their own interests, purely from the standpoint of industrial competition, we have allowed the fiscal question to become improperly

improperly interwoven with the everyday life of the community to an extent that has been responsible for the exclusion of more vital considerations. If the present Tariff Commission succeeds in doing nothing else than abolishing dogmatism on this question, and in causing the leading minds of this State to adopt practical methods for the development of its resources and its industries, an incalculable boon will have been conferred upon the community.

The Commissioner has been induced to refer to fiscalism in this Report because on all hands one hears complaints as to the futility of teaching children trades when there is no opening for their services after they become qualified. The much-vexed question of apprenticeship, concerning which there is so much disagreement between employees and employers in our midst, is an important sidelight upon this phase of the question.

The means of development in all classes of work should go hand in hand with instruction in our schools and colleges, for unless this be done, much of the best that we attempt in educational methods will be so much labour lost. In making this statement, the Commissioner does not lose sight of the fact that the education of our children in these practical ways will, in itself, undoubtedly be responsible for a stimulation of effort throughout the whole of the State; but that effort and the qualification which supports it can be productive of very little definite good unless those in control of the State's affairs will provide the facilities for the utilisation of the educated skill of the country.

There are already signs of a great awakening on this point, and the country will prosper only when all parties vie with one another in their efforts to place the industries of this country upon a permanent basis.

It is undoubtedly true that, apart from our Technical College and its suburban and country branches, little has been done in this State in the way of giving an industrial training to our boys and girls when they leave our public schools. An experience of upwards of twenty years of city teaching life has shown the Commissioner that the great majority of our boys and not a few of our girls look for some "clean" occupation, and readily take positions in offices and shops, while the numbers who choose an industrial calling are remarkably few. The Commissioner does not lay all the blame on the children or their parents for making this choice. The position is forced upon them because insufficient provision is made for teaching industrial subjects, and very little encouragement is given to this branch of education.

In this summary it will be shown what is accomplished in other cities in the United Kingdom, Europe, and America. Attention is drawn in the first place to the admirable system of Evening Continuation Schools seen in working order in London and in some of the provincial towns of England, and in Edinburgh and Glasgow. These are institutions altogether different to our Evening Public Schools, which generally exist for youths whose early education has been neglected. In all the schools named much care is bestowed upon boys and girls who unfortunately have not been well grounded in the fundamental subjects, but the essential part of the training is to fit boys and girls for some occupation in life.

In many of the Evening Continuation Schools of the United Kingdom a stimulus is given in the direction of commercial preparation for boys and girls and a training in the domestic side for girls. A reference to the programme of work set in the Leith Walk School, Edinburgh (see Chapter XXVI on Evening Continuation Schools, Scotland), will indicate what is attempted in these institutions. The course set out in Division IV of this school for the auxiliary classes provides a splendid training for those youths who intend to become artisans. Again, the Sciennes School in the same city has three well organised branches—Elementary, Specialised, and Technical. It is worthy of remark that the Edinburgh School Board (1902) had twenty Evening Classes under its control, and that the average nightly attendance, out of an enrolment of about 3,500, was 95 per cent.

The position of industrial education in England in the lower grades is well exemplified in the well-organised Evening Continuation Schools carried on in the Higher Grade Day Schools under the supervision of the various School Boards (1902). The Leeds Evening Schools (see Chapter XXV, on Evening Continuation Schools, England), is a splendid example of English industrial methods. The Central and

and Cockburn Higher Grade Schools on the commercial side, and Leeds Institute and Jack Lane Higher Grade School on the technical side, supply the children of the masses with excellent opportunities, at the most nominal rates, for acquiring a training for the counting-house or the workshop. Birmingham and Manchester have several similar institutions. The school in the latter town has a very comprehensive commercial programme.

This is the elementary grade of industrial education, provided for the working man's child in every large town in England and Scotland. Our own city, quite comparable to many of these towns in point of population and commerce, gives its growing boys and girls small inducement to follow this class of work. We must pay attention in the very near future to this form of technical education in the interests of those who leave school early and gain but a limited equipment for the work of life.

In Paris and several of the larger cities of France those pupils who are destined for an artisan or commercial life are early provided with the means for assistance toward that end. For such children the Professional Upper Primary School exists. As set forth at page 98 of the Commissioners' Report on Primary Education, these schools are designed to produce commercial employees and workmen, whose services may be immediately utilised at the counter and in the workshop. The words of a Minister of Industry and Commerce, speaking of this class of schools, are worth requoting: "It has become indispensable to place at the service of our merchants well-prepared assistants and to furnish our manufacturers with select workmen, and this is the work of the Practical Professional School."

The organisation for technical education is greatest in Germany. In the schools for the masses the curriculum provides for very little technical training for the boys, and for the girls only those indispensable subjects such as needlework, housekeeping, and cooking.

When the pupil passes through the Volks-schule, generally about the age of 14 or 15, he may enter—in some places his attendance is compulsory—one of the Fortbildungs-schulen. These institutions are numerous throughout Germany and in the populous centres; several of them, specialising in various directions, may be found in the same city. The curriculum, broadly stated, includes drawing and kindred subjects, commercial subjects, mathematics, science, German language. The number of these schools, their aims and objects, viz., to continue the general mental development of the pupils, and to help them to become efficient in their trade, the equipment, the staff, the teaching methods, the attendance, are all points of extreme interest to anyone interested in industrial education, The Commissioner was very much impressed with the amount of time and attention devoted to drawing in these schools. The reason for this is, probably, that the subject is so necessary in the constructive arts that many of the pupils, who are in some States apprentices, find it to their advantage to get the theoretical part of their instruction at the schools while gaining the practical part in the workshops. The work of the Municipal Continuation School in Dresden has been chosen as a type of the instruction given in the German Continuation Schools.

Holland has a well-organised system of industrial instruction in its housekeeping, crafts, and professional schools. In the housekeeping schools the teaching is very practical. The aims of these institutions are to prepare the girls for the duties of the home, to fit them for positions as servants or assistants in shops, and to give them such an education as will make them intelligent housewives. The classes are small in number, which allows for much individual attention, and the curriculum is essentially on domestic lines. As showing the nature of the instruction in this direction, it may be noted that in one of these schools a class of girls was seen repairing and renovating by a process of darning old and much-prized and very worn carpets. Embroidery work is a distinctive feature in the school. The pupils in attendance (about 200) were between the ages of 13 and 18. The fees are nominal, and the schools are subsidised by the province and city.

The Ambachts schools (crafts and professional) are particularly interesting institutions. The one seen in The Hague has an attendance of upwards of 300 boys, between 13 and 16 years of age, undergoing a three years' course of training in one or more of the following handicrafts:—House-painting and decoration,

decoration, furniture-making, carpentering and builders' work, and mechanical engineering. This Trades School has a very fine equipment, and a staff of twenty-four instructors. It is a day institution, but is attended in the evening by more adult students, who use its equipment and instruction to become more proficient in the particular trade they have chosen. For this class the instruction is both theoretical, chiefly drawing, and practical. The day students, leaving at the age of about 16 or 17 years, find ready employment in the wood and iron trades at small wages. These wonderfully practical schools made a strong impression on the mind of the Commissioner, both in regard to their aims and methods. A history of their origin and their growth in The Hague is given in a translation of a late report appearing in Chapter XIV, on the Trades Schools of Holland. They are extremely popular institutions judging by the numbers in attendance, and their great recommendation lies in the fact that they receive their pupils fresh from the schools at the end of the primary course, and supply at once an objective to each pupil in attendance. They are subsidised by the Government, the Provinces, and the Municipalities, the last-named being very liberal in their support. Such schools are worthy of imitation in other parts.

The country, which in its social conditions bears the nearest resemblance to that of our own, is America. Many of the educationists of that country, those in charge of schools as also assistant teachers, make visits to Great Britain and the Continent, and by this means are enabled to keep in close touch with the various educational developments taking place. During the Commissioners' tour in Europe Americans were met with in many cities, and a large percentage of the tourists were teachers in search of fresh educational ideas. Their long summer vacation, which lasts for nearly two months in the public schools, and the quick and not expensive service, give the American teacher a splendid opportunity for travel with the view of gaining information on professional subjects. American teachers were met at Nääs, in St. Petersburg, in Switzerland, in Germany.

Unfortunately a visit to Europe is impossible of accomplishment by the majority of our teachers. The journey is long and the expense is great. The desire to go abroad, even with these odds against them, is growing among our teachers. Those who have taken the journey, even a hurried one, speak of the great advantages gained, and have been so impressed with what they have seen that they have inspired others to do likewise. There is very little that is educationally new on the Continent that does not find its way, if it can be satisfactorily applied to new conditions, into the schools of America. While it certainly is impracticable for many of our teachers to visit Europe, it is possible, even in a short vacation, say, three months, to visit America with some profit. Of course, if the time were longer, say, six months, a very full insight could be obtained into the American system of education.

The Commissioner would strongly urge on those teachers who desire to travel for purposes of gaining professional knowledge, especially if they are restricted to time, to make America their objective, for in that country (*e.g.*, in the Eastern States, in such towns as New York, Worcester, Springfield, Boston; in the Central States, in such towns as Chicago, and St. Louis; or in the Pacific States, in such towns as San Francisco and Los Angeles) they would find systems and methods of teaching based on the best ideas of the Old World modified and adapted to the conditions of the New World. Such an experience gained by our intelligent, observant men and women would, without doubt, result in a still further modification and adaptation suited to our own Commonwealth.

The resolutions passed at the great Conference in Easter, 1904, to send some of our ablest and brightest young teachers to other countries to study the theory and practice of Sloyd, and to receive a training in domestic economy and housewifery, were well received by the delegates. It is sincerely to be hoped that the resolutions will not be lost sight of. The practice of sending young people out on such a mission is recognised by several of the English training colleges and some of the commercial colleges in France and Switzerland.

To America, then, the Commissioner considers we may look for much in the way of school systems and school results that is sure to help us in the ideals at which we are now aiming. The fine primary school system which obtains in many of the States, the magnificent secondary school system which may be seen in any town of importance, have already been referred to in the previous reports. The

industrial life of America remains to be summarised. Much of what has been written in that fine book "America at Work" came under the notice of the Commissioner during his stay in America, but his greatest attention was bestowed naturally on the institutions existing for pupils between the ages of 14 and 18 years, and in this respect he unhesitatingly gives the highest commendation to the Trades School of America. He saw these institutions in different States, but the two that he has selected for full report—the Lick and the Wilmerding in San Francisco—are, in his opinion, the best. Lick, the founder, uttered a noble sentiment when he said, "Having been brought up in narrow circumstances, earning my own living in early manhood as a mechanic, I sympathise with the struggles of the young for a place in life, and I have resolved to found a school where those who are dependent upon themselves can receive such an education as will give them a foothold in the world."

Both schools were visited by the Commissioner without notice, and the regular work inspected. One school deals with the machinery trades, the other with the building trades. They are under separate Boards, but the same head. The policy differs somewhat in the early years of attendance, but the main object of the instruction, viz., to finally turn out *tradesmen*, is kept steadily in view.

In the Lick School the first care is to cultivate in the pupil power and judgment, good tastes and correct habits of thought and action. Little by little this educational process gives way to the consideration that social conditions require that every member of the community, if he is to be successful, must know *thoroughly* something, and the ultimate object of the courses is to afford each student an opportunity to acquaint himself with all that pertains to one of several of the most important industrial pursuits. What the school aims at is carefully set forth under the heading of Trades and Technical Courses. (*Vide* Curriculum, Chapter XVIII.)

The Wilmerding School is open to any earnest, industrious boy who wants to learn one of the building trades, as an integral part of his education and preparation for life. It aims, however, to give something more than the mere equivalent of a workshop apprenticeship. It is the policy of the school to make the training of apprentices as broad as may be feasible without sacrificing thoroughness of workmanship. It is not expected that all will become foremen or independent proprietors in after life; but it is not to be questioned that each will have a better prospect because of the advantages afforded by his school training.

The Commissioner has before remarked on the earnestness, the industry, the attention to study, of the American schoolboy. He reiterates that statement, and on this occasion applies it to the pupils in the Trades Schools. American boys undoubtedly have great opportunities, in all the large cities at any rate, for acquiring the very best education, and they are to be commended for the excellent use they make of them. The Lick School has for its first care the cultivation in the pupil of good tastes and correct habits of thought and action; the Wilmerding offers to its pupils a preparation to enter upon the duties of free citizenship, and in addition to send out into the world students who have acquired a thorough mastery of their trade. Leaving out the practical results of both schools, and including only the moral aspect of the question, the Commissioner is of opinion that the manners and morals of the pupils, as seen under instruction, are of the highest standard.

Without question the establishment in Sydney of such schools as these would mark an epoch in our industrial life. What an opportunity presents itself for one of our rich men to move in this philanthropic direction! In any case, whether by private enterprise or Government subsidy, Sydney should have its Trades School.

The subjoined tables show the numbers of pupils between the ages of 14 and 18 attending the various classes in the Technical College, Sydney, and its suburban and country branches, viz., 3,601, during the year 1904. Of this number, 2,300 attend classes in Sydney and its suburbs. These are satisfactory numbers, but, considering the many who leave our schools every year without any preparation for industrial work, the establishment of Trades Schools in centres where handicrafts prevail is desirable. Such schools would be well placed in districts like Newcastle, Lithgow, Broken Hill, Balmain.

As evidence of the inclination of the youth of our community, these tables will prove somewhat instructive.

RETURN

Return shewing the number and occupations of Individual Students between the ages of 14 and 18 years who attended classes at the Sydney and Branch Colleges and Classes during 1904.

Occupation.	Armidale.	Ashfield.	Albury.	Bathurst.	Broken Hill.	Cobar.	Dubbo.	Goulburn.	Granville.	Grafton.	Hillgrove.	Lindfield.	Lismore.	Lithgow.	Maitland and District.	Maclean and Ulmarra.	Newcastle.	Newtown.	North Sydney.	Orange.	Petersham.	Ryde.	Sydney College.	Surry Hills, Sydney.	Waverley and Woollahra.	Illawarra District.
Agents' Assistants																							2			
Art Metal Workers' Assistant																							1			
Architects' Pupils		1							2						1								13			
Attendants																	1									
Assayers' Assistants					4																					
Bacon-curer																							1			
Bakers' Assistant																							1			
Battery Boy											1															
Bicycle Mechanics								1															5			
Boilermakers' Apprentices					3												8						27			
Box-makers																							2			
Bricklayers' Assistants		1	1									1		1	1				2				2			
Brickmakers' Assistants																	1									
Blacksmiths' Assistants				1		2			2					1			7						19		1	
Bootfinishers' Assistants						1																	4			
Carters					4			1						1			1				1		8			
Car-cleaners																							1			
Coke-trimmers																							1			
Chemists' Assistants																							13			
Carpenters' Assistants		3		1	4	1		2	4	1			1	2			15		11		6		72			2
Cabinetmakers' Assistants									1								2						13			
Cooper																							1			
Clerks	1	14	7	12	11	3	1	9	3		3	2	2	6	7		29		6		38	1	122	2	12	4
Carriagebuilders' Apprentices									1								2				1		6		1	2
Coppersmiths																	1									
Coal-miners and Coal-mine Employees.																	15									
Clipper																										1
Changers														2												
Cordial-makers						1																				
Dressmakers' Apprentices															1		1				2		1			
Draftsmen								1	1														6			
Domestic Servants																							1			
Dentists															1		1						4			1
Decorators																							21			
Drillers																	1									
Dairymen's Assistants								1				1														
Drapers														1	2											
Engravers		1																					5			
Electrical Engineers' Apprentices.					2												1						13			
Electricians' Assistants																		1					13			
Engineers' Assistants and Apprentices.		7						1	15				1	13	5	1	43	1			2		114		1	
Engine-drivers, Firemen, and Stokers.																	8						1			
Farmers' Boys				1											1								2			2
Factory Hands																	4						1			
Farriers' Assistants																							4			
Fitters and Turners				1				1	4								6				1		53			
Flatters															1											
Gasfitters																	1									
Glaziers' Assistants					1																					
Grocers		5							1						1											2
Glaziers' Assistants																							2			
Hairdressers' Assistants																							3			
Hat Manufacturers																							1			
Ironmoulders' Apprentices														1			3						12			
Instrument Makers' Assistants.																							2			
Ironmongers' Assistants																	1						1			
Jewellers' Assistants									1									1	1				10		1	
Labourers					2			2	1					1	1		2						2			1
Lift Attendants																							3			
Locksmiths																							1			
Laboratory Assistants														1									3			
Letter-cutters																							2			
Machinists									2					2							1		3			
Matmakers' Assistants																							1			
Masons										1													7			1
Modellers and Plasterers																			1				5			
Messengers		1		3	2	2		5						2			2				3		13			
Milliners									1														1			
Mechanics				1																						
Mill Hands															2											
Miners					1						3			4	1											6
Mine Employees														2												3
Nurserymen, Florists, and Gardeners.								1	2						1								4			
Orchardists									2														1			
Opticians' Assistants																							3			
Pastrycooks' Apprentices									1					1			4						7			
Patternmakers' Apprentices																							3			
Potters' Assistants																	2				1		40			
Painters			1	1				2							2		20		2				187			
Plumbers' Assistants				4																			4			
Piano-fitters																							2			
Picture-framers																							1			
Paper-cutters																							1			
Postal Assistants																							2			
Photographers								1	3					1			3						40			3
Printers				5																						
Plasterers' Assistants		1		1													1									
Road Maintenance Men																							1			
Rubber-workers															1											
Reservoir Assistants														2												
Sample Boys								1																		
Storekeepers																							2			
Stovemakers																							1			
Slaters																							1			
Saddlers' Assistants																							1			
Stationers																	2	2					10			
Signwriters' Assistants									1														3			
Sawmill Assistants					4																		46		3	
Shop Assistants		2	3	8	5	1		3	[illegible]			1		2			6				3		6			
Sewing Assistants																							1			
Scalemakers										1													2			
Switch-boys																							1			
Soapmakers																										

RETURN shewing the Number and Occupations of Individual Students, etc.—*continued.*

Occupation.	Armidale.	Ashfield.	Albury.	Bathurst.	Broken Hill.	Cobar.	Dubbo.	Goulburn.	Granville.	Grafton.	Hillgrove.	Lindfield.	Lismore.	Lithgow.	Maitland and District.	Maclean and Ulmarra.	Newcastle.	Newtown.	North Sydney	Orange.	Petersham.	Ryde.	Sydney College.	Surry Hills, Sydney.	Waverley and Woolahra.	Illawarra District.
Surveyors' Assistants	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..
School pupils	3	8	24	44	14	..	..	66	39	..	..	2	..	13	80	7	45	..	3	4	30	6	279	3	38	30
Students	..	6	..	5	..	..	..	4	2	..	6	..	..	..	4	..	5	..	6	..	3	..	102	..	5	2
Tailoress	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Tea-blenders	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Teachers	6	..	2	2	14	5	2	4	2	18	1	..	1	10	23	6	11	..	..	3	2	..	18	..	..	3
Tanners	..	..	..	..	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..
Tinsmiths	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	1	..	..	..
Trunkmakers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Typists	..	2	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	1	..
Teamster	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Umbrella-maker	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Warehousemen's Assistants	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	12	..	1	..
Wireworkers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Woodcarvers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	..	..
Woodturners	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Woolclassers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..
Watchmakers	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
No Occupation	63	22	7	44	2	5	9	41	16	25	..	2	2	13	62	16	80	5	5	6	19	1	420	3	17	..
Totals	73	75	45	134	80	21	12	147	110	46	14	9	8	82	199	30	334	10	38	13	115	8	1,846	8	81	63

Grand Total, 3,601.

SUMMARY of Returns shewing the number of Students between the ages of 14 and 18 years who attended classes at the Sydney and Branch Colleges and Classes during 1904.

Locality.	Number of Students	Locality.	Number of Students.	Locality.	Number of Students.	Locality.	Number of Students.
Armidale	73	Granville	110	Newcastle	334	Sydney Crown-street Book-keeping class	8
Ashfield	75	Grafton	46	Newtown	10	Ulmarra	8
Albury	45	Hillgrove	14	North Sydney	38	Waverley	23
Bathurst	134	Lindfield	9	Orange	13	Woollahra	58
Broken Hill	80	Lismore	8	Petersham	115	Wollongong	63
Cobar	21	Lithgow	82	Ryde	8		
Dubbo	12	Maitland and District	199	Sydney College	1,846		
Goulburn	147	Maclean	22			Total	3,601

XXX.

EVENING CONTINUATION SCHOOLS.

[J. W. TURNER.]

As stated in Chapter LVI of the Primary Report there is great need for a more thorough equipment of school buildings for teaching special subjects. Rome was not built in a day, and the great expense that will have to be incurred in this highly important departure must of necessity be spread over a number of years. We must, however, arrive at this result in sections, and by selecting centres affecting large areas we can, as a first step, do much to accomplish what is necessary in this direction.

A workman, no matter how qualified, must have suitable tools, and the expense of providing them must be definitely faced, and at once, if any good is to come out of educational reform. Continuation Schools will do a work in this community where a prolonged school career is rendered impossible for many reasons, and will be responsible for that specialisation which is so necessary to industrial success. It will be necessary for prompt measures to be taken by those in control to declare what money will be available for this and other points of vital reform so that recommendations from those qualified to make them may be made.

In this country, as in others, it is necessary for the majority of children to leave school at or before the age of 14 years. In regard to the latter section it has been the practice of the Department to exempt the child concerned from further attendance at Day School on condition that Night School is attended. The standard of these Night Schools has, in consequence, largely centred around pupils of this type, and has practically not risen above the necessities of the three R's. In the case of a few special pupils of course higher standards have been aimed at, but, for the most part, the Evening Schools have been of the simple character indicated above. There will always be a need for such schools, but they can scarcely be classed as Continuation Schools, for they can hardly be said to *continue* the teaching of our Superior Public Schools. As a matter of fact, they are substitutions for that phase of instruction comprised in our class standards, II to IV. Up to the present we have only been concerning ourselves with that class of children taken prematurely from school through family necessities, and the dullards who cannot keep pace with the progress of the other scholars, and whose deficiencies have to be provided for by the extra instruction represented by the Night School.

In the great Co-ordination Scheme which will take years of thought and patient effort to evolve, the principle of continuation towards higher developments will take its proper place.

In the minds of the average parent—and the Department is somewhat to blame for it—there has existed the idea that the obtaining of a certificate of being sufficiently educated marked the fitting moment for the work of the teacher to cease and the child to be withdrawn from attendance.

When our people realise that our Primary Schools, with all their best work, can only take a child just to the fringe of anything in the shape of that general knowledge which should constitute a schooling, it will be better for the educational welfare of the country at large.

Probably no more important feature remains to be introduced into our system than that represented by Continuation Schools. Other countries have realised this important consideration, and are making it an item of close attention.

The earnest desire on the part of various educational authorities to enrol pupils in Evening Continuation Schools immediately after they discontinue attendance at the Day Schools, and the practice adopted by several schools of returning the school fees

fees in the case of those pupils who make regular attendances, and in other schools of reducing the fees in favour of pupils under the age of 16 years, show the great amount of attention and encouragement given to those children who are forced by the circumstances of their parents to leave the Day Schools early to take up the duties of life. Every town of any importance in England and Scotland has its Evening Classes, but the splendidly co-ordinated system existing in the Leeds Schools, and the varied and comprehensive scheme of work in the Continuation Schools of Manchester, afford the boys and girls of those towns the greatest facilities for educational improvement in all branches, but especially on the industrial and commercial sides.

The buildings of the Day Schools belonging to the Leeds and Manchester School Boards are used for the pupils attending the Evening Classes, and as many of these buildings are well equipped with workshops and laboratories for day pupils, little extra expense, in the way of apparatus, is incurred for the night classes.

In the scheme of specialised work for the Superior Schools of this State, suggested by the Commissioner in Chapter LVI of the Primary Report, the need for thorough equipment of school buildings for teaching commercial subjects, science, and manual training is pointed out.

With the establishment of Superior Schools as indicated, no further provision, except in the matter of staffing the schools, would be necessary for the working of Evening Continuation Schools. The most suitable centres in the city and suburbs could be selected, according to the particular needs of the locality, whether industrial or commercial. In the provincial towns of the State, evening classes for one or both branches could be established in the local Superior School.

The buildings and equipment being ready, the Department should put forth a strong effort, through its teachers and otherwise, to enrol all pupils leaving school between 12 and 14 years of age, or even later, in one or more of its Continuation Classes. In doing so the Department would be following the good example set by Scotland, Leeds, Manchester, Birmingham, and other places. The great good achieved by Continuation Schools in the old country is unquestioned, for, while the teaching prepares boys and girls for earning their own living, it secures them from the temptations consequent upon hours of idleness, and contributes towards the early acquirement of good business habits.

XXXI.

XXXI.

MANUAL TRAINING IN PRIMARY AND SECONDARY SCHOOLS.

[J. W. TURNER.]

In summarising on this all-important educational element, your Commissioner could not do better, in the first instance, than invite attention to the remarks of Commissioner Seath, of Canada. In a short phrase he supplies a text which in itself forms a basis for the attitude of all progressive countries upon this important point. The purpose of Manual Training Schools is admirably put, and the claims of this particular form of youth-training are defined in such a way as to appeal to all in our midst whose aim it is to place the educational affairs of our own country upon a true basis. He states: "They (the Manual Training Schools) specialise in manual training; the English and the Latin schools in English and the languages. Indeed, it is maintained that the Manual Training Schools are more important educationally than are the other two classes of high schools, for they educate the whole nature—the creative as well as the acquisitive powers. . . . They prepare young men, whose funds and time are limited, for positions as designers, draftsmen, and superior workmen, many of whom eventually become foremen and managers; and, with the education they give, a man of ability may rise to any position in industrial life. Not all a man's education is attained at school or at college."

America, without doubt, is the best guide for Australia in this class of educational development, and Canada seems to be shaping her system on the best of American ideals, and will probably improve upon them.

As regards the British Empire, Canada is being held up at the present time, and deservedly so, too, as the most progressive and prosperous of British possessions. It is, therefore, of interest to note the methods in force there in regard to that phase of industrial education of which manual training is the forerunner.

In New South Wales our primary school system has been singularly devoid of anything in the shape of industrial education. The teaching of the three R's in our smaller schools, reaching to higher standards in the same direction in our superior schools, represents the whole of the State's efforts in the matter of education of this type. Our Technical College has been a thing apart from our primary system, despite many earnest and well-meant efforts to make it a supplementary agent to primary school work. Such efforts have egregiously failed, because they were of a patchwork character. Success in this direction can only be obtained by a proper co-ordination scheme based upon a true conception of educational evolution. The different sections of our educational system have been worked independently, whereas they should have been worked upon the principle of interdependence. As a consequence of our crude system, our primary schools have been developed very creditably on certain lines; but, as already pointed out, those lines have excluded industrial education as an integral part of primary school instruction.

The Technical College has been most unduly taxed with having to include in its course a lot of the preliminary work which should have been comprehensively and scientifically taught in our upper primary schools. The idea that these schools should take some of the inceptive work has never been seriously considered, and this, perhaps, is not to be wondered at, for those who have controlled the Education System in the past have been absorbed in a lot of detail work of one character only, and have lived apart from the educational influences of the older and more experienced countries which have developed their educational systems in accordance with industrial needs. It might also be added that those whose responsibility it was to shape the educational policy of this country were not afforded sufficient opportunities of altering their ways. However, that time is past. Through the medium of the Commissioners' Report it has been made abundantly clear that the

primary school curriculum must be broadened in the direction of industrial instruction. Probably seven-tenths of our children finish their education in our ordinary primary schools—that is to say, within the age of 14 years—and it stands to reason that if within this, their only educational course, they are not influenced towards manual training in all its industrial forms they will in all probability never have any predilection in that direction.

It is idle to complain of our lads drifting to offices and other avenues of clerical employment so long as our educational system aims solely at fitting them only for those positions. The betterment of the industrial conditions of the country absolutely depends upon the tastes and views of our children, and these must be determinately shaped in our primary schools, otherwise there can be no true development.

Our Technical College of to-day is supplying in some degree (on the practical side at any rate) the instruction given in the Manual Training High Schools of other countries, but just as our great metropolis of Sydney has outrun the development of the country upon which it depends, so the Technical College has become too much focussed. We must carry all forms of education to all the more populous centres of New South Wales. The Central District School System will largely meet this difficulty, particularly if the curricula of such schools be made to include a sound preliminary course of manual training and technical instruction.

The establishment of a manual training high school or a trades school which would carry the pupil on from the courses of the primary school and ultimately prepare him for earning his living, or if he desired, for admission into the higher Technical College, is necessary in any well-defined scheme of industrial education.

In a less number of centres branches of the Technical College can advantageously be established, and can supplement throughout the country the work of our reconstructed primary schools.

Our *immediate* course of action, however, is undoubtedly to broaden the scope of our primary schools in the direction of manual training, and to extend technical education throughout the country.

As sidelights upon the specialisations of the older countries that can afford to concentrate their educational forces in such directions, the following particulars may prove of some value.

We in this State cannot get results in industrial education unless we adopt practices and methods which have proved so successful in other countries that have given years and years of study to the development of industrial subjects. If we confine our investigations to a study of two countries, America and Germany, we will have sufficient data to indicate the position. Let any one examine the educational facilities of these countries, and he will soon see wherein their great industrial strength lies.

High Schools.

One of the most striking features of American educational development is the provision made for the pupils to move forward in their studies by means of high schools or advanced primary schools which take up the work at the stage of the 8th grade of the grammar school, that is about the completion of our 6th class standard. In some American cities 9th grade schools have been established in addition to the high schools for the express purpose of holding those children who cannot remain on sufficiently long to complete the full course of the high school. In these higher grammar schools the pupils average over fifteen years of age. The curriculum in some of them embraces Latin and French in the highest classes, in others a specialisation is made in the direction of industrial instruction. A good example of the latter class is that of the William T. Lincoln School in Brookline, whose programme on the practical side appears in Chapter XXIII of this Report.

The splendid system of secondary schools, which are so thoroughly correlated to the work of the primary schools in many of the American States, wins the admiration of all interested in education. In the Commissioner's Report on Secondary Education he has described several of the High Schools of America, principally those whose courses are on academic lines. In this summary some attention will be given to the High Schools which give a direction towards industrial work through their manual training classes.

Status of the Manual Training High School.

The Manual Training High School of America, in the majority of cases, if not in all the States, holds equal rank in the minds of the people with that of the English or the Latin High Schools. This was very soon apparent to the Commissioner on his visit to the different American cities. The citizens of any one city would point with pride and pleasure to their schools in which their boys and girls were being prepared for the professions, but with no less gratification would they direct attention to their schools in which their children would get some equipment for industrial and commercial life.

Literary Requirements.

While there can be no question that the teaching in the Manual Training High Schools is, in the more advanced classes, at least, a preparation for industrial pursuits, it is also true that a very broad training is afforded on the literary side. The curriculum of these schools is opposed entirely to any narrowing down process or a preparation along purely mechanical lines. Courses in English, French, Mathematics, and Science are common in all schools; German and Spanish are occasional; all schools have the ordinary courses, viz., Drawing, Workshop Instruction; certain schools provide courses for girls in Art and Domestic Science, and commercial classes.

Manual Training High School, Philadelphia.

The value of the literary side of training was well put by the Chairman of the Manual Training High School, Philadelphia, when he said, "It is not the purpose of this school to produce mechanics, any more than it is to produce any other class of specialists. What it aims to do is to surround boys with the realities of life in both thoughts and things, and to fit them more closely to their environment. It is a system of education which is perfectly general in character, and which is recommended with the same confidence to the future student of the humanities as to the prospective worker in force and matter."

Time Table.

The time table of this school provides for five parallel lines of study, as follow:—

First ...	... English Literature, History, and living languages.
Second ...	... Mathematics.
Third ...	... Science.
Fourth ...	... Drawing, &c.
Fifth ...	... Manual work.

The time table shows thirty periods of work per week, and the time allotted is as follows:—

Literature, &c.	Five Periods.
Mathematics	Five Periods.
Science	Five Periods.
Drawing, &c.	Five Periods.
Manual Work	Ten Periods.

In the third and last year of the course, the time for literary subjects is increased nearly one-half, while that for manual work is decreased fully one-half (*vide* table Chapter XXI).

Commissioner's

Commissioner's Impression.

During the Commissioner's visit to this institution, he was much impressed with the organisation, the methods of instruction, the character of the boys in attendance, and the facilities offered for a good training. Comparisons between the opportunities afforded boys in Philadelphia and those in Sydney were mentally drawn, and the wish formed that something would be done for our own lads, to give them equal chances with the American boys.

MANUAL TRAINING HIGH SCHOOL, SAN FRANCISCO.

The Manual Training High School of San Francisco has for its aims:—

(*a*) The continuation of the manual training of the Grammar School.
(*b*) The emphasising of the educational value of manual training.
(*c*) The emphasising of the great practical value of manual training to those who are to follow mechanical pursuits.
(*d*) A preparation for entrance into the Californian Universities with science, agricultural, and commercial sides.

In this school boys and girls sit in the same room for the academic instruction, but separate for their manual training. Graduates of the school are admitted to the Science Colleges of the State University, Berkeley, *without examination.*

Courses, etc.

The courses on the literary side are even more liberal than those of Philadelphia, as Latin is included among the languages. German and French are not only taught as literature but are regularly spoken in the classroom.

The periods of attendance in the San Francisco school are thirty-five in the week, and the time is divided in this manner:—

English Literature, Languages, etc....	11	periods.
Mathematics	5	„
Science...	5	„
Manual Training	14	„

(*Vide* Chapter XXII).

GIRLS' HIGH SCHOOL, NEW YORK.

Much of the instruction in America, both primary and secondary, is on the principle of co-education of the sexes; but the city of New York, in both classes of its secondary schools, academic and manual, appears to favour separate institutions. This is the case in the Wadleigh High School already described in the Secondary Report, and in Chapter XXIII of this Report a High School in New York, devoted largely to technical works is described.

Courses.

The School has two courses—

(*a*) A two-years' course.
(*b*) A four-years' course.

The Two-years' Course.

This is divided into twenty-six periods each week, and the allocation of subjects is as follows:—

First year—

Languages—English; French; German; or Spanish	10	periods.
Home and Social Science	4	„
Commercial Subjects	6	„
Physical Culture and Physiology	2	„
Drawing, &c.	3	„
Music	1	„
	26	

Second

Second year—

Compulsory—	Languages	10	periods.
	History	3	„
	Physical Culture	2	„
	Music	1	„
		16	

Optional.—The optional list offers a wide choice including applied art, printing, dressmaking, millinery, commercial subjects, physics, library training, manual course. (*Vide* Chapter XXIII.)

The Four-years' Course.

The compulsory subjects in the four-years' course of the New York Girls' Schools are English; Latin, or German, or French; mathematics; science; Greek and Roman history; English and American history. The optional subjects include Greek, Spanish, commercial subjects, domestic science. It will thus be seen that specialising can only take place concurrently with a broad general education (*vide* programme. Chapter XXIII).

Manual Training in Canada.

Canada has made very fine provision for kindergarten teaching, and the schools endowed by the benefaction of Sir William Macdonald provide useful instruction in elementary manual training; but, as in our own State, very little development had taken place in the higher primary and secondary schools. With the object of improving the technical side of the work in these schools a Commissioner visited America. The visit was made about a year before the New South Wales Commissioners reached America. There is something of interest in the results and conclusions of the two independent commissions. There is much in common between the people of Canada and those of Australia, and our national life is closer to that of Canada than to any other country visited.

The finding, then, of the Canadian Commissioner will be of some moment to us in this State. In the first place, he points out the value of sloyd work in the school. In the next place, he summarises the arguments for manual training as a necessary element in all education. He then alludes to the economic aspect of manual training, and concludes by pointing out—(*a*) that of High School pupils, a large percentage of those who enter manufacturing establishments do so as clerks or office hands; and (*b*) that of those who enter from Public Schools, many leave school before they have completed the studies of the form. It is to be regretted that too many of our own boys and girls prefer the "genteel" occupations, and that there is a disposition on the part of many others to leave school early for work.

The Canadian Commissioner, by the medium of a circular to the principals of High Schools in the province of Ontario, found a consensus of opinion in favour of a manual-training High School course; and it also came to his knowledge that manufacturers generally favoured the introduction of manual training into both public and high schools.

His recommendations are :—

1. That for educational purposes, manual training, including instruction in domestic science and art, be placed on a par with the other subjects on the programmes of both the High and Public Schools.
2. That for economic purposes—
   - (*a*) A system of evening classes for artisans and others be organised and put in an effective condition.
   - (*b*) That provision be made in the High School regulations for extending the educational manual training into courses of a technical or semi-technical nature, forming departments in existing schools, but taken, when possible, in separate high schools.

It

It would be necessary, the Commissioner points out, to differentiate the character of the teaching according to local conditions, but in every school he emphasises the paramount importance of a good academic education in English, science, and mathematics. He considers that the American system, which connects the educational training of the elementary classes with the technical training of the high school, is within the reach of Canadians, and likely to suit their conditions.

This, too, is the system that the New South Wales Commissioner advocates as the best for our own State. The two Commissioners did not meet, but they travelled over much the same ground, and their conclusions on this point are almost identical. Canada made a great advance in elementary technical education when she introduced two competent men from England under the Macdonald benefaction. If we in this State are to reap early results in manual training, we must without delay import the trained teacher with a full knowledge of English and Continental methods. He should be attached to our Normal School, so that every student before he leaves should carry away with him the best and newest ideas on the subject.

When the New South Wales Commissioner was in Dublin he found that a trained teacher from England had been selected to reorganise the manual work, and a similar appointment had been made in Glasgow. Only for the matter of time the Commissioner would prefer that two or three of our own trained students, with a bent for manual training, should be sent to England and the Continent, or America, to gain information on the subject, and on their return, to take up the work in our Normal School. Students who would do credit to the position may readily be found. This remark applies with equal force to those of our female students who are now in charge of cookery and domestic science classes.

An aspect of the question of the introduction of educational reforms is that of expense. All countries with an expanding educational policy have to face it. The amount paid in some American States for the up-keep of their schools, especially where free education prevails from the kindergarten to the University inclusive, is astonishing.

The Canadian Commissioner, when he returned home, recommended "That in view of the importance of Domestic Science and Art, and of Manual Training with its technical extensions, the Legislature should for a time stimulate their introduction by a special grant, proportioned in each case to the magnitude of the undertaking, and limited only by its liberality and a due regard for other departments."

Sweden—its Efforts for Improving the Social and Industrial Conditions of the People.

Sweden is the home of some of the best ideals for the improvement of the social and industrial conditions of its people. It has introduced the system of sloyd teaching, which many educationists consider is the best form of manual training for primary schools; it has developed physical culture to such an extent that its methods in this subject are copied in other continental countries and in America; it has inculcated patriotism by means of its sagas, music, and games; and it has established People's High Schools for the instruction of the peasantry in civil, patriotic, and practical questions. It has forgotten no section of the community. It has its schools for the education of abnormals and of neglected children.

In respect to the education of deaf mutes Sweden is in the forefront of European nations. According to law, the education of such children is a *public* concern, under the supervision of County Councils, but with important assistance from the State, which also exercises a certain superintendence over the institutions. Newly-erected buildings, for the deaf and dumb, have been provided at a cost of £110,000. Instruction is *obligatory*.

By the law about institutions for the blind and a statute for them, passed in 1896, the instruction of the blind became *obligatory* from the beginning of 1899.

Schools

Schools for idiots were the last of the abnormal institutions to be introduced. These schools are supported by County Councils, societies, and private people, and subsidised by the State to the extent of *250 kronor for every teachable idiot in the schools, and 100 kronor for each pupil in the working homes. The majority of these schools are under the management of women for all subjects excepting gymnastics and wood-carving, because women, owing to their gentler and more patient temperament, are considered best fitted for instructing idiots, an occupation which tries these qualities. *Working Homes* were erected, when it was found that pupils, who had left the schools, could not stand the humiliation of associating with workmen normally gifted.

Working Schools for disabled people were established in Sweden over twenty years ago, and are supported in some districts by the County Councils, but more generally are maintained by philanthropic societies. The schools make a point of giving the disabled people a professional education, the instruction being joinery, turning, shoemaking, basket-making, brush-making, and, wood-carving for male pupils; and linen-sewing and art needlework, lettering, weaving and stocking-knitting, for the female pupils. In Stockholm and Gothenburg orthopedic cliniques are established for those pupils needing treatment.

Its institutions for ill-principled and neglected children are organised on the model of the famous French Institution of Mettray. The establishment enjoys a State grant of 6½d. per day *per capita*. Pupils are received from the age of ten to fifteen, and, if found necessary, they can be retained there till they have reached twenty. The same practice obtains in the Bastö Reformatory, Kristiania. The City of Stockholm has established a school for those children, who, without having been prosecuted show an evil disposition. According to the law dealing with the classes of children mentioned in this paragraph, criminal or ill-principled children under 15 years of age come under the jurisdiction of the educational authorities, not by the ordinary Courts of Justice. Regarding culprits between the ages of 15 and 18, the Court has the right, in case the imprisonment to which they are sentenced does not exceed six months, to convert this punishment into reception at a public reformatory. Besides, the law prescribes, that in every school district there shall be a Board to take charge of the ill-principled and neglected children of the district.

One of this country's finest ideals is to be found in its institution of workshop schools for the poor of its great cities. What a boon such schools have proved in the direction of uplifting the moral character of the people! In Stockholm alone, a city with a population of 300,000, about 1,600 of the poorest children have in these workshops, *during their leisure hours*, found a refuge, where they are put to a useful occupation, instead of roaming about in the streets and markets, and being exposed to the temptation of begging and pilfering. It is claimed for the workshops—(*a*) that they have proved one of the best *preventive* means against the vagrancy and criminality of the young; and (*b*) that thousands of children have been brought into safety without having had to be taken from their parents and put into reformatory or industrial schools.

Would that we had schools in Sydney fulfilling the same mission! The boys of school-age that we see in our streets and other public places are made up of three classes—the casual absentee who is on the school-roll, but taking a short holiday on his own account; the regular truant who, perhaps, has absented himself for a considerable period; and the boy who attends no school. In the last class are newsboys and such lads, for whom special provision should be made. The establishment of a truant school would be an effective deterrent in the case of the first and second class. The boys of the third class specified cannot be expected to make full time in the ordinary schools. Such boys are necessary in every large city for the benefit of the public. If, then, some portion of the school day is lost by them the State should provide the very best substitute for the regular school work. Toronto, a well-governed city of Canada, has solved this question. There, newsboys and shoeblacks have a school of their own, which they must attend daily at hours convenient to themselves. The instruction is very practical, and is carried on by the most sympathetic of lady teachers. The cost to the State of this school is no more expensive

* A krona = 1·10 shilling.

expensive than that of any of the public schools of the city. The Commissioner saw the school at work under ordinary conditions, and he can testify to its usefulness. The Inspector of City Schools, J. L. Hughes, Esq., holds very pronounced views in favour of such institutions.

The working schools in the cities of Sweden are even more practical than this fine Canadian school. They go further in the direction of teaching trades to boys and girls. The hours of attendance are much the same in both schools, but in Sweden the pupils get one meal a day at the school.

The Commissioner feels that he must again be very outspoken on the great evil of truancy in our midst. An experience of upwards of twenty years in populous areas of our city shews him how great is the necessity for urgent legislation to cope with the evil. In Chapter XIII. of the Summary, Primary Report, at pages 87, 88, 89, 90, 91, he has set forth clearly the course necessary to adopt. Some of these truants are growing up in complete ignorance. It has been stated that some who have been sent to the reformatories are unable to read or write the simplest words, and in the schools attached to these institutions they have of necessity, although their ages are often high, been placed in the lowest class. This condition of things is not to the credit of our State. But this is not the worst feature in the matter. When boys are habitually roaming the streets and parks of our city they are acquiring bad habits and vicious practices. For these there is only one course, which has already been pointed out. For the lad who waits upon the public the working school of Sweden or the newsboys' school of Toronto should be introduced. It is the opinion of the Commissioner that such a school would be popular with our newsboys, especially when they came to see the benefits the school offers. The hours of attendance should be short and at the time convenient to the lads. Attendance should be obligatory.

XXXII.

XXXII.

DOMESTIC SCIENCE—NEW SOUTH WALES.

[J. W. TURNER.]

In reviewing the special subjects which call for embodiment in a national educational system, one cannot escape from those prosaic necessities such as cookery, laundry-work, and other phases of domestic life. Perhaps, one should not say prosaic, for upon the proper fulfilment of such functions depends most of the comfort, and it may be added a great deal of the health, of life.

Most of the women in the Commonwealth of Australia to-day, who have to cook, to sew, and to wash, have had to learn these duties themselves in their own homes, and have had little or no instruction to guide them. In any well-ordered country such important considerations as these call for very serious attention; but, as yet, all that New South Wales can claim in this direction is a large number of very simple sewing classes, and a much less number of cooking classes, and nothing in the shape of laundry instruction at all.

In order to introduce these features into our system in anything like an effective way, the conditions of our girls' schools will have to be thoroughly reorganised. To inculcate the principles of housewifery into our girls, and to provide for their proper instruction in the domestic duties of life, which most of them will be called upon to fulfil, is an urgent measure that should claim our immediate attention.

As regards the teaching of needlework, we can certainly claim to have a well-organised and very general scheme in operation. Perhaps it goes far enough. One is inclined to think that it does. The instruction in city schools is, of course, far ahead of that in the country, as is only natural. Efforts have been made to introduce machines into our schools, and there is much to be said for that class of instruction, for if we had to depend on our clothing being made by hand we would have to pay more, and wait longer for our various articles of apparel.

The part played by the sewing-machines in domestic life is indisputable, but the objections offered to the introduction of machines into schools have been based on the very solid grounds of expense and interruption of other schoolwork, through noise. After all it is purely a question of money, and if we had sufficient funds we could buy the machines and provide for isolated teaching. That time, however, is not yet.

As regards the teaching of cookery, that has to be thorough. It cannot be effectively taught without proper appliances and the necessary ingredients. A certain expense has to be incurred in connection with the establishment of every school of cookery, and no compromise is possible. There is no subject in a girls' school that should receive greater attention than this. The enormous amount of injury caused to the general health of the people through improper cooking and ignorant preparation of viands, is far more widespread than people imagine. Indigestion and stomachic disarrangements are very common in our midst, and are largely the result of the ignorance of our womenkind in preparing suitable meals. It needs, therefore, no special plea for the placing of this subject in the forefront of the school course for girls, and in advocating a comprehensive scheme of instruction in this subject, the Commissioner feels that he will be supported, not merely by those of epicurean tastes, but by the common sense of the community.

Over fifteen years ago a college of cookery was established at the Model Public School, under the management of Mrs. Fawcett-Story, with an attendance of sixteen students, several of whom had been trained as regular State school teachers in Hurlstone Training College. On the completion of the course six cookery schools were established, which subsequently were increased to nine. This has been the total development, in regard to the numerical strength of the cooking staff, that has taken place in the past fifteen years. For the quality of the work done by the staff

 of

of teachers and for their general management, both in the permanent and temporary cooking schools, there is the highest commendation. In both these respects our own work compares most favourably with the best that is done in the United Kingdom, Europe, the United States, or Canada. But so small an increase in the teaching staff and consequently in the number of cookery schools is not commensurate with the importance of the work or the needs of our girl pupils.

The foundations of cookery instruction were well laid fifteen years ago when we took our *trained teachers* from Hurlstone Training School, and the success which has followed the introduction of the work is to be attributed to these young women, a few of whom are with us to this day. Our present arrangements for training candidates for the duties of cookery teachers are not sufficient. It is widely recognised that the young aspirant for the office of teacher should be equipped with a good secondary education, and this applies with as much force to the student qualifying for positions on the side of manual training and domestic science as it does to the one preparing for the Academic School. While free to admit that a very fine selection of girls from the highest classes in our Superior Public Schools is made, the fact remains that in almost every case the period of commencement is too young and the standard of attainments on admission too low. That we have done so well up to date is due to the introduction, at the very beginning of the cookery movement, of enthusiastic well-educated young women from our public training school.

The duties of our cookery teachers are so important that it is absolutely necessary that our girls should have a good education in the first place, and a large experience in their profession in the next. The people of New York see the necessity for a good general education with a domestic science course, as may be gathered from their Syllabus, appearing in Chapter XXIII on Manual Training for Girls in America. The soundness of such a scheme is very evident, and the establishment of such a school in this city would be a very wise step. But a building and equipment for such a purpose, although its success would be assured, cannot be considered in the present circumstances of the State. It is, therefore, necessary to make the best of what we have, with the addition of some necessary, easily effected improvements.

Within our own Department we have at the present time at the Model Public School, Fort-street, a cookery school with an attendance of thirteen students, each undergoing a training of four years. Of this number only about four or five will be available as trained teachers each year. Our defect in the past has been that the cooking centres have not increased in anything like a fair proportion, and under present arrangements the rate of progress will be small. The immediate remedy for this seems to be an increase in the number of candidates at the Fort-street centre. It is advisable that the candidates, on admission, should have reached a good standard of secondary education; but until a high school and training college are established for domestic science, our superior schools must still continue to supply the demand. To carry out this arrangement, an additional inexpensive building could be erected near the present site and equipped with the necessary fittings. While the practical part of the present training is very satisfactory, it would be necessary to amplify the syllabus, so that the student could obtain a broad grasp of the duties she would have to perform as a teacher.

The training of teachers for our own work should be kept at the Fort-street centre, the general teaching of the subject in public classes could well be continued at the Technical College. The lady in charge at Fort-street, Miss Rankin, is quite competent to introduce courses in domestic science, and to continue the very satisfactory practical work, and she should be placed in charge of the cookery school and be supplied with a properly-qualified assistant.

When the time comes to send one or two of our tried teachers to foreign countries to learn the best methods, with a view to improving our own system of education, our lady teachers of cookery who have made good use of existing opportunities should be chosen.

The New Zealand cookery teachers are meeting with much success in the country parts and at a nominal expenditure by means of the Primus stove. The suggestion that our students at Hurlstone should get some rudimentary knowledge of cooking during their course is worth consideration. No one cares to load up further an already severe course which has to be accomplished in the short space of

a

a year, but the great importance of the subject would almost warrant the step. It is only suggested that the simplest instruction dealing only with the main principles of cookery should be given, and it is believed that this would entail no great amount of study, while it would be a most useful acquisition for our teachers. Under an extended course of training for our girl students domestic science should form an important part of the curriculum.

When our teachers are thoroughly trained for our cooking centres it will be necessary to pay proper salaries. The cookery teachers at present in the Service, especially those who have been engaged in the work since its inception, have not received adequate remuneration for their duties. Such work deserves to be better paid.

This provision for teaching in domestic science can only be regarded as temporary. The only way to gain the greatest success is by the establishment of a properly organised high school of domestic science with an attached training college. The immediate pressing need can be met by the enlargement at Fort-street, and the introduction of first principles of cookery into Hurlstone.

Having trained teachers in the duties, cookery classes would soon follow.

As regards laundry instruction, there is not the same necessity for making it as general as cookery instruction, but so necessary a feature of housewifery should call for more attention in our State schools. Laundry work is very creditably taught in the Parramatta Industrial School for Girls. In fact, it is a subject of instruction that is specialised in that institution. With respect to the paraphernalia necessary it is by no means costly, nor would the services of special teachers in large centres represent much expenditure of money.

In the suggested course of study on domestic science suitable for students in a technical high school, time has been set apart for housewifery and laundry work. The Board Schools of London introduced both these subjects in 1902, broke down all prejudices, and made a great success of the teaching. The Commissioner has described the work as he saw it in some of the schools, in Chapter XVIII of the Primary Report. He now learns, through J. P. Walton, Esq., Chief Inspector of Schools, West Australia, who recently passed through Sydney on a visit to America and Europe, that in some of the large schools of that State housewifery and laundry have been introduced into the regular courses of instruction.

A little housewifery is taught in our own schools, as a reference to our Domestic Economy Course will show, but as the teaching consists of "demonstration talks" mainly, it can only be considered a poor substitute for the actual work.

It is desirable to have these useful everyday branches of domestic work thoroughly taught in our schools. It is well that every girl should be trained in the work of the house—in the first place to assist in the management, and in the second place to receive a preparation for household duties, which she will be called upon to fulfil either in the capacity of an employee or in charge of her own home.

In order to facilitate the consideration and introduction of such subjects of instruction as these, conferences of qualified people are necessary. Through the work of such conferences the Department would be placed in possession of data upon which to base its action. The question of cost would be most thoroughly gone into, and those entrusted with the work of reorganisation would have placed before them definite schemes upon which to act.

XXXIII.

AGRICULTURAL EDUCATION.

[J. W TURNER.]

Probably the greatest reaction that is taking place in New South Wales is that connected with city and country occupations. The eyes of the public are being rapidly opened to the disastrous consequences of crowding into cities and neglecting those avenues of employment which lead to profitable production. Throughout the years gone by, a voice would occasionally be heard crying in the wilderness, prophesying dire disaster through our omission as a people to cultivate the arts of husbandry, but these solitary notes of warning fell upon heedless ears.

Speaking generally, there has been an utter absence of method in the matter of industrial development, agricultural and otherwise. The principle of *laissez-faire* has ruled supreme, but the necessity for intelligent and discriminating State interference in this important direction is being realised by both the press and our political leaders. The outlook is therefore hopeful. Every department of the country's work calls for the utmost concentration and specialisation in place of the haphazard ways of the past.

Droughts, floods, and bush fires have driven many people off the land, and the city has had to open its gates and shelter these defeated hosts. But provision can be made against drought, flood waters may be diverted, and the ravages of bush fires most certainly minimised. Our land laws, too, stand greatly in need of liberalisation. Under the present state of things the hardships of a country life are proverbial. Let us hope that, by thoughtful legislation in well needed directions, the way of the husbandman will be made easier, and his success in life quicker and surer.

What the Commissioner saw in his recent travels through many countries has opened his eyes to the criminal fallacy which has so long been a British delusion, viz., that the Government of a country should stand aloof from industrial enterprise, and permit all those engaged therein to work out their own ends without supervision (which sometimes means restriction), assistance, or advice. The highest politics of a country are those connected with industrial development, and to secure success in this direction expert departments and State facilities for specialisation must be provided without stint.

To secure the best results there should be a scheme of *co-ordination*. For instance it would be idle to educate our lads in agriculture unless we at the same time provide ready facilities for putting them on the land under suitable conditions. As an evidence that the necessity for co-ordination will not be overlooked, it is pleasing to record that the disposition of the leading minds of the State at the present time is to make agricultural education go hand in hand with such a radical change in our land administration as will present opportunities to thousands of our sons who have been shut out from agricultural life in the past.

Local Government, Irrigation, Closer Settlement, must all be brought into active operation simultaneously with agricultural education; and no higher deed of patriotism could be vouchsafed to any State than the successful fulfilment by our public men of a great national scheme of husbandry.

Nothing interested the Commissioner more than the development of agricultural methods in the different countries through which he passed. With a knowledge of our country's needs gained through a long residence in the West, he paid, as far as time would permit, very close attention to this branch of his investigations, and he feels assured that the information he has collected will prove of great value at the present time. In this summary a brief outline is given of the methods in force in other lands.

In France the teaching of agriculture is introduced when the pupil is about 14 years of age, and, on the boys' side, is a decided preparation for practical farm life. In the girls' department the instruction is in horticultural subjects, theoretical and

and practical; and the lessons are given by regular members of the staff, whose training has been received by means of courses of practical gardening taken in the training schools. The teaching is systematic, intelligent, and general, for the object of those responsible for public education in France in regard to this branch of education is to keep the people on the land.

Our duty in New South Wales is to afford people sufficient inducement to go on the land. When that has been accomplished we can learn a lot from France in the art of keeping them there.

Holland is without doubt a standing object lesson in the matter of organisation of agricultural teaching. Everything in connection with the teaching is very thorough, and details are attended to in a marvellous manner.

In Holland practical instruction in agricultural subjects is introduced into the schools at a very early stage. Every school, whether urban or rural, provides for a course of nature study, and, throughout the six years' course, lessons on plants, animals, &c., are of daily occurrence. Attached to the Practising School of the Haarlem Training College is a very large garden for the use of pupils and students. The time-table of the school is given, and its construction, particularly with regard to the number of lessons daily, will no doubt attract the attention of our teachers. The excellence of the system, however, is seen in the splendidly organised Higher Agricultural Schools.

At the top of the list stands the College of Wageningen, an agricultural university, which comprises four distinct schools:—

A.—A Secondary School. Course, four years for boys up to 17 years of age. Final certificate here qualifies for the Higher School of Agriculture. A general education given.

B.—Intermediate Agricultural School. Course of two years for boys 17 years and upwards. A class in this school with a one-year course, forming in reality a continuation school. A third-year course is given for the benefit of those pupils specialising in colonial agriculture preliminary to filling positions in the Dutch Colonies.

C.—The Horticultural School—two-years' course for practical gardeners.

D.—The Higher School of Agriculture and Forestry—two sections; one for home, the other for Colonial agriculture.

Winter Schools.

Next come the Winter Schools of Agriculture and Horticulture, which are intended for the sons of farmers and market-gardeners. The State pays all the expenses of these institutions, excepting the buildings, which are provided by the various municipal bodies. The schools are opened for the six winter months, viz., from October to March, and the course extends over two years. Pupils are admitted at the age of 16 on the primary school standard, and must shew some practical knowledge of farming or gardening. A reference to the time table of the Agricultural School at Groningen, Chapter XLVII, will convey some idea of the practical nature of the work done in these institutions.

Society for Public Good.

These Societies, generally supported by private philanthropy, are found in many of the large Continental cities, but were particularly noticeable in Paris, Belgium and Holland. The Dutch Society, it is asserted, has done more than any Society towards solving the problem of dealing with the unemployed. The main features of the Colony formed under the auspices of this Society are:—

(a) Committees from various towns in the Netherlands send unemployed to the Colony.
(b) Primary Schools exist for the children.
(c) Continuation Schools, attendance to 16 years of age compulsory, are part of the school system.
(d) Special Schools follow on for industrial pursuits, civil service appointments, army, navy.
(e) Intermediate Schools of agriculture, horticulture, and forestry have been established.

One

One great feature of the work carried out in this Colony is the amount of land that has been reclaimed and brought under cultivation. One can well understand that these two occupations alone would afford constant employment to a considerable number of people. The Colony is not self-supporting, but depends upon subscriptions and legacies.

For excellence of kitchen-garden products, Belgium stands in the very front rank. The large tracts of land given up to vegetable gardening are numerous throughout the country, and the quality and variety of the produce are of the very best. One of the finest schools on the Continent is the Superior School of Agriculture for Girls at Hévérle, which includes an agricultural department where the girls are taught among other things the duties of farm life. A splendid well-kept vegetable garden, almost entirely the work of the lady teachers and pupils, testifies to the practical worth of the teaching methods employed.

Belgium has its lower and higher agricultural schools. That at Vilvorde, near Brussels, belongs to the former type, and is intended to train youths for positions as practical men on the soil. That at Gembloux is a university, and fits its students for the higher positions of industrial life. It has a very comprehensive curriculum, a very fine equipment, and possibly grounds, which for soil and situation are not surpassed in any part of Belgium.

Switzerland one might designate the home of cultivation. No arable space is wasted. In the harvest-time women and children take a large share of the work of the vineyards and fields. The provision for instruction in agricultural subjects is good. In the primary schools a direction is given to the instruction, and in several of the larger cities excellent agricultural colleges are in existence. The Agricultural College at Lausanne is attended by youths who will succeed their fathers on the soil. It is a practical college for sons of farmers and vignerons. A short course in agriculture is given in the Training College in the same city. The curriculum of the Agricultural College is comprehensive and practical. The attention given to viticulture is easily understood, when it is considered that Lausanne is the centre of one of the best wine-producing grape districts in that part of the world.

The practices of the Canadian people in regard to educational matters are always deserving of our careful consideration. A recent cablegram informs us that the great school philanthropist, Sir William Macdonald, has again given proof of his excellent judgment in the selection of a good cause on which to bestow his wealth. The well-organised and splendid McGill University, Montreal, ranks among the best of modern institutions; the endowment by him of Manual Training Schools in some of the large cities of the Dominion has placed Primary Education in Canada, in this particular, quite on a level with the best schools in the United Kingdom and America; and his latest offer, viz., to establish and endow at a cost of several million dollars an experimental farm college for training teachers to educate Canadian youths in the art of farming, shows him to be a citizen not only possessing the disposition of a public benefactor, but possessing sound judgment regarding the distribution of his wealth.

With a keen recognition of what immense importance it is to the State to possess a prosperous husbandry, the Commissioner cannot refrain from referring to Goldsmith's well-known lines :—

> "But a bold peasantry, their country's pride,
> When once destroyed can never be supplied."

In penning these lines one cannot but think that Goldsmith must have keenly realised what a superstructure the agricultural producer was to the State, and how dangerous a thing it was to the ultimate prosperity of the country for this class of workers to become extinguished.

New South Wales has had its fair share of mineral wealth, and doubtless there is still much more to follow, but we can no longer disguise from ourselves that our permanent prosperity depends more on the husbandman than the miner. The riotous richness of Lambing Flat did not last long, and the present prosperity of the Young district, due solely to agriculture, is much to be preferred to the ephemeral splendour of the golden days of Tipperary Gully.

New South Wales.

Primary Work.

The question now presents itself: *What bearing have these conditions on our own State? Is there anything we can learn from these institutions? What advance have we ourselves made in the teaching of so important a subject as agriculture?*

Certainly we have nothing in the primary schools of this State that will compare with the systematic practical courses which are so general in France and Holland; but it would be unfair to some of our teachers in rural and other districts if their individual efforts in the direction of agricultural teaching were not recognised. In the ranks of our teachers we have men whose knowledge of the subject is quite equal to that of their confrères in continental countries, and whose work produces just as good results. The only difference between the two is that in our State such teachers are very few, whereas in the countries named they are found in many schools. In the latter case, agricultural knowledge has been obtained as a regular part of the training college course. To reach the same standard of work a similar course must be introduced into our training college system.

Until this plan is adopted we can never hope to make agricultural teaching general in our schools; but as a starting point, it would be well to employ teachers who have made a special study of the subject in their schools, and who have proved that they possess both theoretical and practical knowledge of tilling the soil, in visiting and instructing teachers in various parts who shew some aptitude for the work, but who are in doubt as to the right way of making a commencement. These proved teachers of agriculture on an elementary scale are not doing enough for their country when they are restricted to the immediate neighbourhood of their schools. Their value in any community is great, but they are only benefiting the few. They should be out among the many, disseminating the knowledge they have gained by long experience.

To this State of New South Wales the teaching of agriculture, among our primary industries, means much, and it is of vital importance that we should adopt the very best methods for developing the subject. It is generally acknowledged that something should be done to prevent the congestion in large cities. The City of Sydney, including the metropolitan area, has one-third of the entire population of New South Wales. Agricultural teaching, agricultural knowledge, disseminated in our public and secondary schools, will do much towards inducing settlement in the country.

The following scheme of instruction in agriculture in public schools is put forward as likely to be productive of some good:—

Agricultural Education in Public Schools: A Suggested Scheme— Travelling Teacher.

Objects.

(1) The objects of the scheme are to diffuse a more comprehensive idea of the natural forces in agricultural production.

(2) To instil progressive and intelligent ideas respecting agriculture, horticulture, viticulture and apiculture.

(3) To illustrate the growth of insect pests, noxious weeds and vermin, demonstrating their ravages and illustrating their enemies and preventatives.

(4) To make suggestions for the treatment of soils, and hence the improvement of crops.

(5) To give instruction in the diseases and sicknesses of animals, likewise their alleviations.

(6) To encourage the management of bees for private and commercial purposes, showing the great loss allowed under apiculture.

(7) To encourage the formation and cultivation of home and school gardens, demonstrating that the growing of symmetrical vegetables and flowers takes no further energy than the growing of distorted specimens, but adds to their commercial value.

(1)

Duties.

(1) To visit outlying localities, giving a series of illustrative lectures on the most important pastoral, agricultural, horticultural, apicultural, and viticultural subjects.

(2) To give evening lectures in the Public Schools, illustrated with views, making the lectures of the most simple character.

(3) To make collection of such botanical specimens, animals, insects, and pests as may be of benefit to the Technological Museum.

(4) To report localities where insects and other pests are allowed to continue their ravages.

(5) To suggest and formulate, where practicable, school gardens in conjunction with the teachers.

Plant.

Horse, conveyance, and food.

A good portable magic-lantern, sheet, string, and hammer.

Six hand magnifying glasses.

Two microscopes.

Two botanical specimen holders.

Entomological requisites.

Gun and ammunition.

Paper for botanical specimens.

Tent for camping out when required.

Cost.

	£	s.	d.
Apparatus	£150	0	0
Travelling expenses per diem	0	10	0
Conveyance and horse	60	0	0
Salary	300	0	0

Agriculture: Secondary Education.

Hawkesbury College.

Our State is to be congratulated on the position it has taken in the matter of secondary agricultural education, and our Hawkesbury College is an institution of which we have good reason to feel proud. It is widely known for the thoroughness of its teaching, for the breadth of its curriculum, and for the practical results of its work. The fact that its accommodation is fully taxed is sufficient indication of its popularity. It well maintains its high aims in preparing its students for the management of farms, dairies, orchards, or vineyards.

The Commissioner has visited the College on several occasions, and has been closely interested in the various sections of its work. He has been much impressed with the splendid organisation that obtains, and the high-class discipline that prevails throughout the establishment. Having been for many years head-master of a school attended by some hundreds of boys between the ages of 15 and 18, he is in a position to understand and appreciate the excellent tone that exists under the able direction of the Principal, Mr. H. W. Potts.

Hard work and long hours is the motto of the College, and no youth passing through its courses, whether practical or theoretical, is allowed to get any other idea. It is proper that this view should be impressed at the outset, for the life of the successful farmer is one of hard, patient toil. It must not be understood that work is excessive, but the industrious life is a striking feature in the institution. It is often urged against our Australian boys that they are not too industrious. The Commissioner unhesitatingly states that the lads of the Hawkesbury Agricultural

College

College work just as industriously as the lads he saw in the fields of Vilvorde, Gembloux, or any other of the great gardens of Europe. Needful time is given for recreation, and cricket and football are well played, but always subordinated to the work of life.

Candidates for admission are subjected to a medical examination, and their physique and general fitness for the particular work of the College are inquired into. The result is that after a few months' experience of the healthy situation, the regular life, the plain but substantial food, a marked improvement physically ensues. The lads of the Hawkesbury College are a robust, well-built set of young fellows. The moral and social life of the students is carefully studied. A large library and a well-furnished reading-room form part of the equipment. One of the College rules directs that all students must attend Divine service once each Sunday.

A post-graduate course is offered in the following sections—dairy, poultry, orchard, piggery, experimental plots, special farm course—to afford students the opportunity of gaining a more intimate practical training in whatever direction they care to specialise.

The institution is an object-lesson in what can be done with the poorest of soils by the use of up-to-date, intelligent methods. It is without doubt the most popular, and deservedly so, of our secondary public institutions. Parents in New South Wales should know that the entire fees for resident students are under £30 per annum, payable half-yearly, and for non-resident students £2 2s. per annum. It is a question for the consideration of the Government whether it is not advisable to proceed with the extra accommodation sanctioned some time back. Such a well-organised institution should be capable of greater possibilities, and it does not sound well when pupils are kept waiting for admission. With the increased enrolment of students an increased staff would necessarily follow. Indeed, a larger staff is already required.

Other State Agricultural Institutions.

Our Department of Agriculture has certainly been very much alive to the needs of the farming population of this State. In addition to the excellent Hawkesbury College, Experimental farms have been established in the south-west, the western table-land, and in the North and South Coast districts. None of these carry on the same extensive courses found at Hawkesbury, but specialise principally according to geographical and climatic conditions.

Wagga.

At Wagga, for instance, on the south-west slope from the table-lands, the production, drying, and canning of fruits, olive-curing, and the making of olive-oil, form the principal industry, and the articles preserved bring high prices in the markets. There were other fine features of work in this splendid farm, the details of which may be found in Chapter XLIX of the Report.

Bathurst.

If we were asked to state what are the best features of the Bathurst Experimental Farm, the answer would be—its splendid wheat plots, its apple orchards, and its market garden, worked on the principle of irrigation. The wheat yield this year, on this farm, was high, and among the very best in the district. In this way it proved itself a veritable object-lesson. The apples grown in the Bathurst district, on this farm and others, command the highest prices in the Sydney market. The institution is a most valuable one, and is patronised largely by sons of western land proprietors. All the vacancies are filled both here and in Wagga, and candidates are always waiting admission.

Wollongbar.

Wollongbar was established to meet the requirements of the dairy-farmers of the North Coast district, spoken of by all who have seen it as our greatest agricultural asset. It does not appear that this splendid school as yet is getting the support it merits.

Berry.

Berry.

This school, situated in our South Coast, is established to give instruction chiefly in cattle-breeding and dairy-farming. It has not, to date, proved the success that was hoped. The fact that students who have completed the full course satisfactorily, at the Hawkesbury College, may obtain admission into these experimental schools, for a period of six or twelve months, free of charge, to specialise in the courses they offer, gives hope that, before long, they will be fully used by a good class of young men.

The Itinerant Agricultural Teacher.

The value of the itinerant teacher of agriculture has often been discussed. The work done by Mr. M. A. O'Callaghan, the dairy expert, is well known, and, in like manner, Mr. W. J. Allen, the fruit expert, has done much for the orchardist. The need for a travelling teacher, understanding what is necessary of agriculture to be taught in the State schools, has already been dwelt on. Some agriculturists consider that it would be a good plan to send the travelling expert to the farmers in scattered districts, much in the same manner that the dairy and the fruit experts visit certain districts. The work of such experts would be to deal with the chief product of any particular district, and impart the latest and best information on the treatment of that product. Our system of agricultural instruction is good, but it can be better.

Regarding this question of employing experts and others to visit the farmers in their own centres, and by means of conventions to disseminate scientific and practical knowledge of agriculture, the Commissioner is indebted to the Hon. J. S. Larke, Commissioner for Canada, for some information on the subject. Canada and the States have long ago adopted the system of bringing the school *to* the child in the scattered districts, and we are gradually adopting the same ideas. Canada now sends the teacher *to* the farmer, although the teacher is not an expert in the ordinary sense of the word, but a *successful practical farmer* who has already gained the experience so necessary on the part of those who have to teach others.

XXXIV.

XXXIV.

COMMERCIAL EDUCATION.

[J. W. TURNER.]

Probably no subject in the scheme of public instruction is receiving more attention to-day than Commercial Education. In communities throbbing with the operations of commerce in its manifold forms there is, of course, much instruction of a practical nature always proceeding in connection with the conduct of ordinary business. Without doubt, there are many who graduate in this practical school, who become most potential factors in our commercial life, but it is not desirable to leave this important educational development too much to chance or circumstance. It, therefore, behoves us as a community desiring the best form of education, and all the good that accrues therefrom, not only to impart a general education to our children that will fit them for the commercial arena, but to specialise in such a way as will lead to the best possible results. There is rather a tendency in some quarters to assume that commercial education is a stereotyped quantity comprising instruction in the recognised elements of office routine; but probably no subject is more complex, for each class of business stands by itself and requires an intimate knowledge of the conditions of the particular trade concerned. It is, therefore, necessary, in introducing this comparatively new element into our scheme of public instruction to avoid undue specialisation, and, to quote the words of Mr. Sadler, to "work in very closely to the actual needs of business houses." This can only be done by the whole-souled co-operation of the business community.

The friendly relationship and co-operation existing between the teaching bodies and the members of business communities as represented by the Chambers of Commerce have contributed much to the success of commercial teaching in all countries. The impetus given to the teaching of the subject by the London Chamber of Commerce is widely acknowledged, and the splendid achievements in management of such schools as the Commercial High School, Leipzig, and the School of Commerce, Neuchâtel, are due, to some extent, to the influence and support of the Chambers of Commerce in those cities.

The Sydney Chamber of Commerce has, so far as it has been possible for such a body working as a voluntary institution, done much in the direction of this necessary co-operation. The perusal of the Commissioner's report, however, will show how much more can be done in this way. For instance, in Continuation Schools, it would be necessary to ask for what would probably be regarded as considerable concessions from the employing faculty. And this suggests one feature connected with our present system of night schools that calls for special comment. A boy obliged to work throughout the day, in a climate like the Australian one, wants as much open air as possible. When children are exempted from attendance at day school in order to go to work and assist in maintaining the family, it comes very hard upon them after working, say, from 8 a.m. to 6 p.m., to have to attend a night school and put in a few hours of instruction there. As a rule children so placed bring but jaded minds to their classes, and it is doubtful whether any such system of instruction carries with it beneficial results. Night classes will, however, always be necessary, particularly in technical matters, but as far as possible crowding too much into the life of a child working for its living should be avoided.

In Germany, as is well known, it is incumbent on the employer to let the young employee off for a certain time during the day in order to receive the necessary instruction in a continuation school. The principle is a good one, and calls for patriotic co-operation on the part of the employer. It is said that there is no sentiment in business. The Commissioner thinks there is room for a great deal, and unless this quantity be forthcoming, the best results will not accrue either to the nation or to business people individually.

It

It must not be left to a few high-minded employers to follow these beneficial courses of action, because to do so would lay them open to unfair competition at the hands of those who would pursue entirely selfish methods. The movement must be a general one.

Uniformity of practice renders many things possible that would not otherwise be so. What the Commissioner is desirous of avoiding is the introduction of a lot of expensive commercial educational institutions that would represent a superfluity to our community of to-day. He proposes, in his report, while recommending a complete scheme ending with the ideal, to formulate such practical recommendations as will lead to almost immediate alterations in our methods in regard to this all-important subject. Even in Germany to-day, studded as it is with specialisations, there is already noticeable a slight reaction towards practical experience as against organised method. This fact is not in any way gathered from educational works, but from coming into contact with brisk, cosmopolitan Germans from day to day—men who have gone through the whole gamut of these much lauded educational courses, but who are still dubious as to the exact amount of practical benefit they derived from them. However, the Commissioner ascribes much of this testimony to that sense of individuality which is reluctant to admit that it owes too much to anything in the shape of a preparatory course. As regards the routine section of commercial education, this is what our New South Wales schools give pupils an inkling of to-day, and though it may be viewed as the simplest form of commercial education, very few schools that attempt these allegedly simple undertakings succeed in turning out lads who are of any practical use upon entering an office. The reason for this is obvious, viz., that the instruction is mechanical generally, and given by a teacher who knows little or nothing about business methods. It is against this class of instruction that practical men inveigh and urge the superiority of office training.

In our city there is little provision for systematic courses of instruction in commercial subjects Some instruction is given in book-keeping and in the mechanical branches, and in a few of the large Superior Public Schools, a course, including a modern language, commercial arithmetic, commercial geography, mathematics, book-keeping, shorthand, and typewriting, has been instituted; but, as already pointed out, with restricted opportunities for carrying on the teaching. There is no public school in our city with a programme of commercial work that will compare with what is done in the same subject in the Higher Grade Schools of Edinburgh, the Realschulen of Germany, the Upper Primary Schools of France; and there is no provision in any State institution for giving a training in commerce like that which exists in the Commercial Public School, San Francisco, or the modern High Schools of America. Several of our public school teachers are fully alive to the necessity for preparing their boys for a business career, but progress can only be moderate until better organisation is provided.

In regard to the Commissioner's reference to the Sydney Chamber of Commerce, it is only right to add that that body has merited the good opinion of the public by inaugurating a system of examinations and issuing junior commercial certificates, which has done much towards influencing public and private school teachers in specialising in the direction of a commercial training. The Chamber has for some years invited youths of from 14 to 17 years of age to present themselves for examination with the view of qualifying for junior certificates. Pupils from all classes of public and private schools present themselves from time to time, and, generally speaking, the candidates from the public schools are very much more successful than any others. The standard for a pass is fairly high for the boys of the ages specified, and before a candidate can succeed, he must be very well grounded in the obligatory subjects—writing, reading, arithmetic, commercial geography, and commercial history. The Chamber points out that in conducting these examinations the desire has been to obviate anything in the nature of cramming, and it considers that the *careful* training of lads in the selected subjects will result in their better equipment for service as beginners in commercial houses, and render them better able to quickly adapt themselves to business.

In the matter of preparation and examination of school boys for the beginning of a commercial life, the Sydney Chamber of Commerce has come into close touch with our public schools, but a duty devolves upon business firms to place a greater recognition on the junior commercial certificate issued by their Chamber, to

see

see that the lads receive a proper *business* training, and to improve their emoluments. In view of its great interest in the subject, the Sydney Chamber of Commerce might well be asked to extend its support to a scheme for the higher commercial training.

There are a few aspects of the question to which the Commissioner would like to call special attention. Personally, he is delighted with the common sense displayed by Mr. M. E. Sadler, in dealing with this great subject. It is refreshing indeed to encounter a mind which is capable of pointing out the practical difficulties of the situation to the extent that Mr. Sadler has done. He throws vivid sidelights on German and American practice which are of incalculable benefit to those searching for instruction on the point. Because a thing is a success in Germany, and suits America, we are not to conclude that it can be grafted on to our own system of public education without adaptation of any sort. We should all be particularly grateful to the man who makes such a careful analysis of the subject as Mr. Sadler has done. The ethics of commercial education are admirably treated by him, but much of what he urges depends upon certain conditions which may or may not exist. For instance, he lays great stress on parental influence and discrimination in the way of selecting a commercial occupation for a child. Now the Commissioner would like to see more of these qualities in operation in this country, for not only would a teacher's load be lightened thereby, but the State would benefit immeasurably. Mr. Sadler says :—

"If a father, anxious to give his son the best possible training for life, were to take counsel with a number of those who represent the best tradition in English education, I suspect that the outcome of their collective advice might be put shortly in some such form as the following :—

'First, decide as exactly as you can what you want to produce by your son's education ; what kind of man you want your son to grow into ; what principles you want him to live by ; what kind of 'success' you would like him to attain to ; remembering all the time what limitations are imposed on your choice by the boy's own physique, character, and intelligence, by your own means and social position, by the range of your own connections with the business world, and by the general economic conditions of our time.' "

A good many of the parents with whom we have to deal to-day in New South Wales, are not exactly competent to settle these all-important questions for their children. Many others do not take the trouble but leave everything to the teacher, or—alas that it should be so—to the predilection of the child itself. The Commissioner speaks from long experience. Parental insufficiency in this respect of course we cannot help, but parental supineness is a bad feature in our community, and do what we will in our schools the highest results can never be hoped for until parents become both able and willing to undertake these great duties of discrimination and responsibility.

Mr. Sadler lays his finger on another great truth when he delivers himself thus :—" This difficulty cannot be overcome by the simple expedient of sending boys to be educated, from infancy, in another country. Education is an essentially national thing (though, of course, there are many elements in it which are common to all nations), and without the risk of injury to much that is most valuable in character, an Englishman cannot prepare his son for *English* life and *English* business by educating him wholly abroad."

This the Commissioner has taken as a keynote in all his investigations, and in commercial education more than in any other phase is adaptation necessary. Rugged men of the world have said, " Teach a boy to buy and sell, and he'll make a living in any country." Well, probably he would, but the various processes of buying and selling—that is, trading in its full sense—are so differentiated that knowledge acquired in one country will not suffice in another.

This is one of the considerations that go to prove what a very big subject commercial education is. To quote Mr. Sadler :—

" Remember that what you want is not knowledge alone, or energy alone, or good manners alone, or sharpness alone, or a strong sense of duty alone, or good physical condition alone, or firmness of purpose alone, but a due admixture of each and all of these ; and remember too that these things cannot be learnt out of books alone, nor in the shelter of home life alone, nor from a schoolmaster's lips alone, nor from the companionship of other boys alone, but that in any course of education worthy of the name a number of different factors must co-operate—home and school, body, mind, and spirit, master and boys, books and life, words and things, doing and thinking, lessons and games, discipline and interest, theory and practice, imagination and realism, example and precept, old and new, tradition and experiment, reverence for the past, and a bold readiness to reshape the future. All good education is a combination

of

of antitheses. The great teacher is an artist who makes an harmonious whole out of elements which, as they lie before us separated by analysis, look almost incompatible and discordant. Yet all the elements are necessary, though in differing measure, to the completed whole. In nothing is it more mischievous than in education to fall into the falsehood of extremes."

. . . .

"What we want is high intellectual attainment, *plus* strong physique, *plus* vigour of moral character, *plus* the trained intelligence which is able (according to swiftly-discerned need) either to act on its own initiative or to subordinate itself wholly to the collective welfare. We do not want commercial schools which will turn out tame experts whom employers can keep in cupboards on small salaries. We want young men of sturdy moral character; vigorous in body; capable of forming independent judgments; trained to observe accurately, to report exactly, to reason correctly, and yet to be capable of using with skill and good sense what I may call 'imagination in the service of business.' Also—and this is at least equally important—we want progressive employers who can appreciate the right kind of young man when they see him, who value a good preliminary education, and who make a point of giving promising employees the right kind of training inside the business, *i.e.* who won't let a young man of talent rust away in a siding, but will really take trouble to bring him out and give him a chance of getting wide experience and *of bearing responsibility*. The most valuable kind of commercial education is that which a man gets (and can only get) in an actual business house. A man has to learn a good deal of business, as a soldier has to learn a good deal of soldiering, *under fire*, and what in business corresponds to being under fire in the field is feeling yourself exposed to the real risks, and to the unexpected and unprepared emergencies of real trading. You can't artificially reproduce in a commercial school the conditions of real business. It is like imagining yourself to have the toothache—quite a different thing from the reality. But just as a soldier needs some professional training before he goes out on service, so the future man of business needs some professional training before he enters pratical business life. And for the soldier and the business man alike, professional and specialised studies must be postponed until the learner has acquired a sound basis of general education. Premature specialisation is disastrous. It causes atrophy in the very powers which it is intended to cultivate."

This is straight talk from a man who not only knows what he is talking about, but what most other people, of any status, have to say on the same subject. It will appeal to all as good common sense.

Sir Thomas Sutherland, the great maritime director, speaks somewhat in the same vein. He says, and really as a truth it is complete:—

"On the whole, I have some doubt whether the outcry for specialised education towards a commercial career is necessary.

"Of course, if a young man knows that his career will lie in a certain direction, the sooner he applies himself to the special studies relating to it the better it must be for himself. But if no special career should be defined, and a lad has to take his chance of an opening wherever he may find one, then, I believe, he is quite as likely to hit the bull's eye by the help of a good sound general education as by any other means.

"For myself, I was brought up on the classics, which I am sorry to say I speedily forgot, but the habit of thought and perseverance which I learned at school must have remained.

"What we may learn from the Germans, of whom we are always talking nowadays, is the art of taking pains in the minutest things.

"A first-rate man of business is formed of various parts which are not the result of any peculiar system of education, but are due to energy of character and clearness of head, which must be, more or less, innate, but are qualities which may be improved by practice and steady effort."

In the Commissioner's report will be found other evidence from sources of a reliable character, and he has called attention to them because he sees the urgent necessity for avoiding anything in the shape of fads in his recommendations. As best he could in the years gone by, he has turned out thousands of boys from Fort-street School into commercial life, but he has no hesitation in saying, compared with other standards, those under which he has worked for so long have been crude instruments indeed. This is not his fault, nor that of his staff or the Department. The recent conferences have completely extinguished that class of criticism which attempted to condemn men, whose scope of active and working influence was restricted by circumstances over which they had no control.

XXXV.

XXXV.

RECOMMENDATIONS.

[J. W. TURNER.]

Industrial Education.

Having become familiarised with so much that makes for success in the industrial life of the people of the United Kingdom, the Continent, and America, it now remains for the Commissioner to outline what, in his judgment, is best for adaptation in our own State.

The Commissioner emphasises the necessity for following up the recommendations referring to kindergarten and manual training in Chapter XVII of the Summarised Primary Report, and in Chapter XVIII of the General Report on Primary Education, and also the resolutions appearing in pages 140, 141 of the Report of Proceedings adopted at the Easter Conference, 1904. The recommendations to which he particularly refers are numbered 1 to 5, and are as follow:—

1. That a Kindergarten Training College should be established.

2. That as soon as there are sufficient trained teachers of kindergarten the subject should be taught in all infant schools, and schools with a first class in which female assistants are employed.

3. That until the Kindergarten Training College is established, students in Hurlstone Training School should be regularly instructed in the subject, theory and practice.

4. That manual training should be introduced into the lower and middle classes of the primary school to form a link between the kindergarten occupations and the manual work of the superior schools.

   That the instruction given in manual training in the higher classes should be on a more liberal scale, and in accordance with the standards fully set forth in Chapter XVIII.

   That all material, tools, &c., necessary for the manual training workshops should be provided free of cost to the pupils.

5. That a superintendent of drawing should be appointed to reorganise the whole method of teaching drawing in the public schools of the State, and that the greatest care should be exercised to see that a suitable man is obtained from the accredited art centres of London. The information submitted by the Commissioner on the teaching of drawing (see Chapter XX) will shew what is being done in London, and it means everything to the proper reconstruction of the teaching of this subject in our schools that a man of all-round qualifications should be secured.

Proceeding in natural order, after having well laid the basis of hand and eye training, it will be necessary, as the child approaches the age when he will discontinue school to go to work, or remain on to prepare for his calling in life, to provide the means for extending his education. In the case of the former class of children, this provision is well thought out in the scheme of Evening Continuation Schools which

which exist in the schools of Great Britain. (See Chapters XXV, XXVI, XXVII.) Concerning this phase of industrial training, the Commissioner makes the following recommendations:—

Evening Continuation Schools.

That a system of Evening Continuation Schools be established under the Department of Public Instruction, New South Wales, as follows:—

(*a*) Elementary School Instruction.

(*b*) Ordinary Commercial Subjects (for those pupils who have completed Course *a*).

(*c*) Ordinary Industrial Subjects (for those pupils who have completed Course *a*).

(*d*) Special Classes—Commercial and Literary Subjects (for those pupils who have completed Course *b*).

(*e*) Special Classes—Technological Subjects (for those pupils who have completed Course *c*).

This is the work done in the evening schools of Great Britain. We cannot hope to at once reach the standard of scientific equipment that is found in the schools of the Old Country, but we should proceed gradually towards that end. The apparatus, &c., used by pupils of the day school in Britain is at the disposal of the evening students. Some members of the day school staff are employed in the evening school, but experts in the various subjects are also engaged.

Manual Training and Trades Schools.

In the Interim Report, page 487, the Commissioner suggested improvements in our system—

1. By extending kindergarten teaching.
2. By introducing Manual Training in the lower classes of the primary schools.
3. By establishing superior schools with a good equipment for purposes of specialisation.

In this State we have no public school where a boy who elects to follow an industrial or commercial life can get instruction to fit him for the particular calling he chooses. In America every city has seen the need for schools other than those which prepare for literary professions. Certainly we have two excellent institutions in Mort's Dock and the Fitzroy Dock, where the position of apprentice in both is so valued that applications are very numerous, and but few get appointments.

The busy scene at Winterthur, Switzerland, where the Commissioner saw about 100 boys in a Lower Technical School engaged in the engineering trades, and in The Hague, where several hundreds of youths were similarly engaged in a Trades School, is in striking contrast with the limited numbers of youths employed in the same line in our own State. Winterthur has the advantage over us in that it manufactures its own steam engines for railway purposes, and exports to various parts of Europe valuable pieces of machinery. After seeing the success of the Engineering School at Winterthur, one could almost wish that we in this State had the opportunity of manufacturing our own railway engines and other machines for carrying on our mining and other industries. Our Australian boys and girls are quite as intelligent as those in any part of the world, but in the preparation for industrial or any other life, they will be seriously handicapped if we fail to give them opportunities at least equal to those of the other English-speaking countries.

Commissioner Seath, of Canada, who was sent out specially to report on the value of manual training, returned and reported on the necessity for its introduction, and recommended to his Minister that the Legislature should make a special grant to carry on the work. The New South Wales Educational Commissioner, believing in the greatness of our natural resources, would urge a similar course on our own State

State Government. Germany's interest in this form of education is something astonishing. It is not likely that we shall ever reach such a standard, but we ought to make an effort at any rate to introduce some of the American ideas. In connection with manual training the following recommendations are made:—

(*a*) More specialisation in the direction of industrial work in certain of our Superior Schools in the highest classes.

(*b*) The establishment of a manual training high school in the City of Sydney, the system to be gradually extended to other populous centres in the State.

(*c*) The establishment of a trades school in the City of Sydney.

(*d*) That a teacher, with the best credentials, from England or America, and with experience of the Nääs system, be selected as head of the institution.

(*e*) That the recommendation, *passed at the Easter Conference*, 1904, to send a few of our young ex-students to the United Kingdom, the Continent, and America, to study special methods, be considered as of the greatest importance in connection with the new movement in education in this State.

(*f*) The establishment in Sydney of such a school as that in Toronto for newsboys, and the workshop school, which is doing such noble work in Sweden, is desirable.

It is not practicable to establish at the same time a manual training high school and a trades school in Sydney, and as there is much in common in the two classes of institution as regards their aims, it may not be necessary; but if the Commissioner had to make a choice between the two, he certainly would, in the light of his experience of the Lower Technical School at Winterthur, the Tsessarevitch Nicholas School, St. Petersburg, the Ambachts-school, The Hague, and the Lick and Wilmerding Schools, San Francisco, favour the establishment of a trades school.

If such schools as the Toronto Newsboys' Institution and the Workshop School of Sweden tend to minimise the evils of truanting, then they must be placed in the list of useful institutions. The establishment of such schools in Sydney is easy of accomplishment, and the men to conduct them may be readily found.

Domestic Science.

In advocating and recommending technical schools for our boys, it must not be forgotten that our girls should have their opportunities to prepare for industrial life. In domestic science we may not be able to elaborate on such a scale as exists in New York Manual Training High School for Girls, or the two great institutions—Buckingham Palace Road, Westminster, and the Liverpool School of Cookery,—but we should make a commencement towards a systematic course of training, and in this respect the following recommendations are made:—

(*a*) The Commissioner repeats his recommendation—No. 7 in the Interim Primary Report, page 95—regarding the teaching of Domestic Science in our Primary Schools, viz, that the course of domestic economy, as taught in the girls' departments of our primary schools, should be considerably enlarged. At present such course is confined to cookery and needlework. The extra subjects that should be included, and soundly taught, are laundry work, and as far as practicable, other house-keeping methods. These will necessitate careful selection, and sufficient data can be supplied from which to make an appropriate choice.

(*b*) That a trial be made, in one of the ordinary public schools in the city, of the programme, on the manual training side, of the Brookline Grammar School (see Chapter XXIII).

(*c*) That steps be taken without delay to increase the cookery centres.

(*d*) That more candidates be received into the present training school for cookery, at Fort-street, and that the necessary extensions to the buildings to allow of such a course be effected.

(*e*) That the lady at present in charge of the Fort-street Cooking School be placed in charge of all cookery and domestic arrangements connected with primary instruction under the Department.

(*f*) That elementary instruction in cookery be included in the curriculum of Hurlstone Training College.

The plan as above suggested would suffice for immediate requirements, but development in the work must be anticipated, and provision made in the following direction:—

(*g*) That a secondary school be established, in which the general aim of the girls will be directed towards the proper management of the home.

It would not be necessary to put up a special building for this purpose. One of the superior public schools for girls, already in existence in the city, could be used, and the curriculum and courses of study approximated to those obtaining in the New York schools.

(*h*) That a training college for teaching Domestic Science be established.

(*i*) That admission to the college be granted on the final examination at the secondary school or an equivalent standard, but no pupil to be allowed to enter under 16 years of age.

(*j*) That one of our own trained teachers be placed in charge of the training college for domestic science.

It is to be hoped that by the time we are ready for the college, one or more of our experienced teachers of Domestic Science will hold English or Continental diplomas.

Agricultural Education.

We have much to be satisfied with in our efforts towards improving the agricultural conditions of our State, but much remains to be done to complete the settlement of an intelligent, industrious, yeomanry on the land. Systematic instruction in agricultural subjects should form part of the primary school programme.

Such instruction should be entirely free from "bookishness," and the more closely it is connected with Nature herself the more permanent will be the results. It is not given to every teacher, even if he wished it, to conduct courses of lessons in agricultural teaching along these lines. In order that this form of instruction should be properly taught and extended in our schools, especially in farming localities, the following recommendations are made:—

Agriculture.

(*a*) That instruction in agriculture be included in the curriculum of the normal college.

(*b*) That a scheme such as that outlined in Eglinton methods be adopted in our primary schools.

(*c*) That District Model Schools be established in towns situated near agricultural colleges or State nurseries, to be used as school centres for the acquisition of agricultural teaching. The agricultural college grounds might well be used for practical demonstrations and the class-rooms for the elementary scientific instruction. Such schools would be well placed at Richmond, Bathurst, Wagga, Gosford, Campbelltown, Moree, and Cowra.

(*d*) That for the benefit of urban pupils a portion of Hurlstone grounds be set apart under a capable man and teacher as a garden for practical work in horticulture and the cultivation of vegetables, &c.

(*e*)

(*e*) That teachers who have proved successful in their own schools in teaching the theory and practice of elementary agriculture and kindred subjects be employed by the Department of Public Instruction as travelling instructors to visit schools and explain methods of instruction in agricultural subjects. At the outset one instructor would be sufficient.

(*f*) That bonuses be awarded for the best kept gardens in Public Schools, on the same lines as those adopted by the Railway Commissioners for best kept gardens on Railway Stations.

(*g*) That a comprehensive general school exhibition, in connection with the annual Show of the Royal Agricultural Society, of farm produce, &c., be held and prizes awarded

(*h*) That every inducement be offered for schools to take part in District Shows.

(*i*) That a scheme of scholarships be inaugurated in the interests of those pupils living at a distance from model school centres.

(*j*) That a suitable text-book on the subject of agriculture be prepared by an expert in the State.

The Hawkesbury Agricultural College and the various Experimental Farms scattered over the State are taking up the secondary stage of agricultural teaching in a most successful manner. Once the scheme of agricultural instruction in primary schools, as recommended above, gets into thorough working order, a large and steady influx into the secondary schools may be looked for. Several of these have already their complement of students. The Commissioner recommends that the improvements to the Hawkesbury College, which are now at a stand-still, be completed without delay.

With a properly organised scheme of elementary instruction in agriculture in our primary schools, leading up to the excellent secondary schools already well established, it is a matter for serious consideration whether we should consider this the final stage of our teaching. Undoubtedly the agricultural industry in New South Wales is on the eve of a great development. The subject is of sufficient importance in America and Canada to receive university approval, and Wageningen, in Holland, and Gembloux, in Belgium, are university agricultural colleges. A Chair of Agriculture in our own University would, in the opinion of the Commissioner, give a great impetus to the advancement of agriculture in the State and Commonwealth.

Commercial Education.

To come into line with what is best in commercial training in other cities, English-speaking and foreign, the City of Sydney must move in the following direction :—

(*a*) Establishment of regular courses of elementary commercial instruction in certain of the Superior Schools; day and evening classes, pupils of ages from 13 to 16 years; course of three years; leaving certificate on completion of the course.

(*b*) Establishment of a commercial high school for lads of about 17 years of age who desire a training in higher branches of commerce; admission by examination, or in the case of pupils from the commercial department of the Superior School, the leaving certificate to be recognised; course of two years; diploma on completion of the course.

(*c*) Establishment of a Faculty of Commerce at the Sydney University, where students may be trained who are destined to become responsible persons in great businesses or "captains" of commerce.

In connection with recommendation (*b*), the establishment of a *separate* commercial high school is preferred to a commercial department attached to another institution. The curriculum of the commercial department, University College School, Gower-street, or that of the Drexel Institute, Philadelphia, is recommended (with adaptations to our own country) for the proposed commercial high school.

In

In connection with recommendation (*c*), it may be argued that the time is not yet ripe for the establishment of a Faculty of Commerce in our University. That may be so, but we must start to work up to this ideal as a crowning one in a great scheme. In support of the Faculty, it may be stated that England has a Faculty of Commerce (certainly only of recent date) in each of the Universities of London and Birmingham; that Leipzig Commercial High School, which started with an enrolment of about fifty, had, in its fourth year of existence, over 400 students in attendance, a result which far exceeded the most sanguine expectations; and that a commercial course exists in seventeen universities of the United States. The Sydney Chamber of Commerce, the Commissioner is aware, is in favour of establishing a Faculty of Commerce in the Sydney University. The question is of sufficient importance to warrant the most careful consideration of the Senate of the University and the different organisations interested in education.

Conclusion.

In conclusion, the Commissioner gives a full endorsement to the following recently-expressed views of the President of the Sydney Chamber of Commerce, 1904:—"This country must be made a commercial success, and that can be accomplished only by giving the coming generations an education to teach them independence and knowledge of their future responsibilities *that will not set the professions above business as a means of gaining a living. The percentage of men fitted for the highest posts in business is small compared with the total number employed,* and the heads of big businesses, banks, and wholesale firms are always looking out for men of comprehensive training and specialised knowledge. The business field is not overcrowded for the man who can produce results—the leader, the aggressive man, and the man who has a purpose."

XXXVI.

XXXVI.

CONCLUSION.

[G. H. KNIBBS AND J. W. TURNER.]

In transmitting to your Excellency this report of the more striking features of Agricultural, Commercial, Industrial, and Technical Education generally in other parts of the world and in this State, with suggestions and recommendations as to the nature of improvements which, in your Commissioners' opinion, may be effected in the latter, but few things remain to be added. First of all, it may be said that the extended report following hereafter, viz., Chapters I–LXII, is not exactly of the nature of a mere appendix. In many instances this extended report expresses in much greater detail the Commissioners' conclusions or views, in addition to reciting the facts upon which they are founded; and it affords more complete and explicit information as to the character of the technical forms of education in other countries. Questions of educational interest, as well as the whole tendency of modern reform in technical education, are reviewed, especially those aspects relating to apprenticeship and to national industrial efficiency.

Detailed curricula are a feature of the report. The grave limitations of technical education, as organised in this State, which places the native-born population at so serious a disadvantage industrially, as well as in higher technology, can only be understood by thoroughly comparing the courses of instruction. As these are not generally available for other countries, a considerable number of typical instances have been given.

For these reasons, the body of the report is designed to be read in connection with the preceding summaries by those who may take an interest in education at all commensurate with its gravity.

The function of the summarised report is to give, firstly, a general conception of the whole question, prior to that detailed reading which, for the formation of responsible opinions, cannot be avoided; and, secondly, to supplement much that is lacking in the body of the report.

Your Commissioners are prepared to submit, at a later date, a very brief report upon the relation of the University of Sydney to public education and upon the teaching of Art, for your Excellency's acceptance.

These matters, being of much less urgency than those dealt with in this Report, will be treated as the exigencies of public business permit.

In concluding, your Commissioners desire to place on record their profound conviction that a good educational system is the necessary foundation for national progress; that the expenditures for education in this State, judged by those of other similarly situated countries, are not adequate for the normal education of the children of this State; and further, that of all public expenditures, that for thorough education is most certain to be productive.

Your Commissioners desire also to express their conviction that our State is lacking, not in great material resources, but rather in skill in developing them; hence that an improved educational system is full of promise for the State's prosperity.

Your Commissioners feel also that the importance of education can be appreciated only when it is viewed in the light of its influence on national destiny, and they feel therefore constrained to urge that the convictions, reached after an almost world-wide survey of public education, and a prolonged and thorough study, however much they may fail to echo public opinion, should be regarded as given with deliberation, and with a sense of the overwhelming responsibility which your Excellency's Commission has cast upon them.

We have the honour to be,

Your Excellency's most obedient Servants,

G. H. KNIBBS.
J. W. TURNER.

19th September, 1905.

CORRIGENDA.

Remark.—Owing to the pressure of public duties, there has been no opportunity for a careful reading of proofs. Many mistakes are consequently likely to be found; the following have been quite casually observed: no doubt there are multitudes of others :—

Page	81,	line	13,	for	"allied sets"	read	"of allied arts."
,,	126	,,	58	,,	"subdivion"	,,	"subdivision."
,,	127	,,	26	,,	"horlogere"	,,	"horlogerie."
,,	310	,,	34	,,	"techanische"	,,	"technische."
,,	328	,,	16, 21	,,	"Arbiturienten"	,,	"Abiturienten."
,,	329	,,	18	,,	,,	,,	,,
,,	330	,,	16, 33, 46	,,	,,	,,	,,
,,	331	,,	41	,,	,,	,,	,,
,,	332	,,	16, 20	,,	,,	,,	,,
,,	333	,,	17, 21	,,	,,	,,	,,
,,	339	,,	59, 64	,,	"matrikülauszug"	,,	"Matrikülauszug."
,,	401	,,	22	,,	XII	,,	XIII.
,,	488	,,	1	,,	3	,,	13.
,,	631	,,	28, 44, 45	,,	"tubercles"	,,	"tubers."
,,	751	,,		,,	"Arbiturienten"	,,	"Abiturienten."

SYNOPSIS OF CHAPTERS.

CHAPTER IX.

CHAPTER LVIII.

CHAPTER I.

CHAPTER I.

Introductory Observations.

[G. H. KNIBBS.]

1. *Scope of Previous Reports.*—In the Commissioners' previous Reports, dated 3rd December, 1903, 6th October, 1904, and 19th December, 1904, not only was primary and secondary education dealt with, but also some of the more fundamental questions of educational theory and practice. The architecture and hygiene of schools, and their equipment, both as regards material and *personnel*, were treated. The question of the teaching-staff of both primary and secondary schools was considered. The general trend which educational reform must take was also pointed out, and it was shewn that in almost every direction advance was necessary. Educationists, though well aware that neither primary nor secondary education could be regarded as in a satisfactory state, have found great difficulties in making satisfactory progress in the present state of public opinion, and in the face of certain current traditions regarding the nature, value, and importance of various forms of education.

It was also shewn in the Reports referred to that a State educational system having any pretensions to thoroughness must consider the question of the co-ordination of the various branches of education; and, further, that without unity of system in this respect, our educational machinery and scheme could not compete with those of the advanced countries of Europe, or with those of many States of America. It was pointed out, too, that national efficiency very largely depends upon the excellence of the educational system, and that doubtless we have been greatly hampered by failure to make any sufficient forward movement. In the opinions of the Commissioners, our present educational status is more seriously defective than is generally recognised.

2. *General Aim of the Present Report.*—The aim of this Report is to disclose the state of trade, commercial, agricultural, technical and industrial education generally, both in its lower and higher forms, and the state of the relation of these to the development of a State University. Matters incidental thereto will also be discussed. It will be shewn also that the higher activities of the people demand certain forms of encouragement and assistance; and in particular everything that tends to create a scientific spirit, and to provide the State with the necessary material for the higher forms of scientific study and research, with libraries that are available to students of science. There are certain State and other institutions conducted for practical ends, the efficiency of which might be greatly increased, if the conditions of their activity permitted the head officer to devote himself, outside the duties of directing the establishment, wholly to scientific research. Institutions which might be mentioned in this last connection are the laboratories of the Government Analyst, the Chemist of the Department of Agriculture, the Technological Museum, etc.

The libraries of the University, of the Royal Society, the Museum, the Linnean Society, the Technological Museum, and of the various public Departments are of immense importance to the State, and as it developes will become increasingly important.

3. *Comparative Study of Education.*—Throughout, the Commissioners have attacked their task from what may be called the comparative standpoint. Our educational system has not heretofore been sufficiently brought into contrast with the well-organised and developed systems of other parts of the world. There has been no general comparison of our system with others publicly available—no easily accessible source of evidence which permitted our recognising what our educational status really was.

The Commissioners, after a careful review of the whole question, feel that it is important that detailed evidence should be given by them, disclosing the real state of the educational work of other countries. Without this there is liable to arise a dangerous self-satisfaction as to educational method and development, and our very remoteness from the great educational centres and our linguistic insularity lend themselves to the accentuation of this danger.

The evidence submitted by the Commissioners will allow any person who may take a serious interest in public education to study the whole question, and is therefore important, because our educational progress depends upon the intelligent appreciation of the question by those who influence the life of our community as a whole.

4. *Educational Co-ordination.*—Coming to the questions immediately at hand, that of the forms of education remaining to be discussed, it may be observed that the general scheme of educational co-ordination has been sufficiently illustrated in the preceding Reports, see in particular, Interim Report, pp. 469–474; Report on Secondary Education, Summary, pp. 11–14, body of Report, pp. 6–9; Preliminary Report on Agricultural, Commercial, Industrial, and Technical Education generally, pp. 5–6.

Briefly, it may be said, that the beginnings of lower commercial, agricultural, and technical education find their place in the primary school. They should originate in the scientific instruction and manual training, which should form part of the curriculum of every primary school. These subjects, it was

was declared, should have that practical orientation in the primary school, which would compel the pupil to recognise something of the significance of science, and scientific subjects in the practical affairs of life. Only when a community, as a whole, is instinct with an appreciation of science, will it avail itself in any adequate manner of the results of scientific research, or maintain that general attitude thereto, which will ensure a successful exploitation of scientific knowledge.

The higher forms of technical education, it was stated, imply a preliminary training through a higher type of education than is to be found in the primary school. This can be had only in some form of secondary school.

From this point of view, it may be readily recognised how important are the primary and secondary forms of education in securing real efficiency in the lower and higher branches of the more technical forms of education. We cannot neglect the earlier educational steps, if we are to have the later stages satisfactory. The thorough educational organisation of many countries in Europe confers great advantages in this respect.

5. *Our Status in regard to the Technical Forms of Education.*—As is well known, the excellence of technical education in Europe has strongly stimulated educational movement in America and the United Kingdom, and recent progress in the latter countries has in consequence been conspicuous. At the present time not only do technical educationists in Europe visit America, but large numbers of American educationists also are continually visiting Europe in order to keep themselves in touch with the rapid advance being made in every form of technical education, and with the apparatus of instruction.

It is important to bear such facts as these in mind, and to recognise that the technical-education systems, especially of Europe, have had all the advantage which can be derived from the excellence of the organisation of the lower forms of education. The educational traditions that have been developed in Europe, the demand for thoroughness, and the ease with which the authorities could command the services of teachers, qualified not only technically, but also as educators, have co-operated to make the rate of progress and the general status of European technical education very high. And it is not possible for one to converse with a European technical instructor without recognising how keenly alive he is to what may be called the pædagogical elements of his subject.

European traditions also make it impossible for a state of confusion to arise as to the necessity for separating the different grades of technical and professional education. In no European school, for example, would the attempt be made to qualify a student as a professional archithect without demanding the necessary secondary education which is an essential preparation, and in no European school would the distinction between the practical builder and the architect who directs the operations of the former, be confounded. Similarly in regards to other walks of life. The class of instructor qualified to teach the lower technical grades of education is not qualified to teach the higher. What may be called the general educational status of the teacher is consequently more satisfactorily assured under the European system,

In this State, although progress has undoubtedly been made in the direction of technical education, and although excellent work has been done in our technical and agricultural colleges, no one with a competent knowledge of the state of the facts, can pretend that we have kept pace with the progress in the other hemisphere. A careful reading of the report following hereinafter will disclose the fact that our scheme of assuring proper qualification in our technical educators, of delimiting the fields of the various branches of technical education, and of perfecting its whole organisation and administration, leaves much to be desired.

6. *Importance of Technical Education.*—The *urgency* of better technical education is dealt with hereinafter, in a chapter specially devoted thereto. This will reveal the fact that competent English authorities refer in the most serious terms to the absence, so far, of any sufficient national regard to the subject in the United Kingdom. The significance of this to us will be seen when it is recognised how largely dependent we are upon the experience of England for technical development. Our system was borrowed from England at a time when its technical education there was very defective, and although the State had made inquiry into technical work done in Europe, the influence of this inquiry upon our present system is practically limited to the equipment of the University. It has had but little effect on the lower planes of technical education. A competent Commission in the United Kingdom has expressed itself in a report in more strenuous terms about the defects in English technical education than would have been appropriate from the Commissioners. Since that report was written, there has been distinct progress; yet much remains to be done. There is, in the opinion of the Commissioner here writing, abundant evidence that the whole question of education, including its technical forms, must be more seriously regarded in its *national* aspect than heretofore throughout the British Empire, and this remark is peculiarly applicable also to this State.

As evidence of our estimate of the importance of education, it may be mentioned that the expenditure on education in New South Wales is less per pupil or per inhabitant than in any country in the world similarly situated, which can be regarded as having taken the question of education at all seriously. This is the consequence of *the absence of any adequate popular recognition of the dependence of national efficiency on good education;* and of the fact that expenditure upon a wise system of national education not only repays itself by an increase of national wealth, but is imperative for a progressive people. This last remark applies with *special* force to the technical features of our educational system. So long as the sphere of operations in such institutions as our agricultural and technical colleges is kept within proper bounds these institutions ought to be popularly recognised as being not only of very high value, but as essential to our national existence; and it will greatly help us if we generally recognise that their cost to the country has been repaid many times over in the increase of national wealth, although no scheme of book-keeping will directly reveal this. A faith in the certainty that education produces important national results is not yet as strong with our people as it is with those of many other countries visited by the Commissioners.

7. *The Question of Apprenticeship.*—Anyone conversant with the features of our industrial development will recognise that we are still largely influenced by the general condition of things which existed when lads were trained for their industrial and technical occupations by the method of apprenticeship. Throughout the world it is being more and more clearly recognised that among progressive peoples systematic

systematic technical education must supplant the incompetent method of apprenticeship. National efficiency is too serious a matter to be left to the mercy of adversely-interested individuals, or to the conservatism of former practices. It has been thought desirable, therefore, to devote a chapter to the question of apprenticeship in relation to education. It is imperative that, as far as possible, a people shall equip itself in the least possible time, and yet in the most thorough manner for the various callings and careers in which it is engaged. To permit individual interests to sacrifice the general well-being, would be a serious error of policy, and hence the proper standpoint is industrial and general efficiency.

8. *Anticipation of Educational Requirements.*—A State which merely responds to existing demands for education will not be able to compete with that whose leaders have foresight, and who endeavour to anticipate the people's requirements. The demand for certain form of education has been actually *created* in many countries in Europe. For example, the Agricultural High School of Denmark, was the subject of ridicule by the "practical" farmer. But young people were got to avail themselves of the instruction, and very soon the condition of their farms and their wealth were more than a sufficient answer to the "practical" farmers who despised their theory.

It may be mentioned also that Prussia developed the higher forms of education for the express purpose of *creating* a class capable of dealing with the problems of great national consequence, and that, too, when she was broken with war (between 1806–9).

And in France the revelations that came through the Franco-German war of 1870 taught the French nation the importance of technical education, and this fact is acknowledged officially. In the words of M. Courtot, the French had been conquered by education before that fact was revealed by national defeat in arms (see the Chap. on the Higher School of Commerce, Marseilles).

Technical education in Germany, and, indeed, in most countries of Europe, has helped to create industrial activity. The conception, sometimes heard, that we must simply supply such education as is called for by the existing demand, misses the point. To wait for a rapid development of agriculture before supplying agricultural education, would be to hamper our agricultural development: similiarly in regard to other forms of education.

9. *Grades of Education.*—There are fundamental differences in the various grades of technical education which it is important to remember. This has been indicated in the Preliminary Report already referred to (see I., 4, 5, pp. 3–4). It is necessary to maintain unity in the scheme of instruction and to prevent attempts to create a higher out of a lower school. Each has its proper function, and each is essential in a complete educational system. But the equipments, and the scheme of qualifications of the teachers in the one case, do not fit one institution for doing the work of another.

10. *Importance of Educational Outlook.*—There is a point to which far more serious attention must be given if progress is to be satisfactory, and that is educational foresight. A community affords multitudes of examples of serious expense and loss, and of the extinguishing of opportunity through a failure to anticipate the future requirements and developments. This profoundly affects educational advance, and it will be good economy if, in future, we more carefully consider our plans of extension.

It is necessary that all present action should be taken with the probabilities of the issues of the future clearly before the mind.

Our present schools are, for example, almost without exception wrongly constructed. In a multitude of cases they completely fail to take account of the contingency of future development.

11. *Importance of the Elements of Higher Education in relation to the lower.*—So-called "practical" men often express themselves in favour of the lower forms of education, and treat the higher forms with contempt and neglect. This attitude arises from the fact that the inter-dependence of the various forms of education has been insufficiently studied. No one, acquainted with the higher forms of education, who will give the matter due consideration, and who will take account of the necessity for the development of the lower can fail to recognise how much a system is dependent upon the higher elements for its general development. The efficiency of all classes of teachers depends upon their coming under the influence of teachers of higher grades. And no country can educationally thrive that does not make provision for the influence of the higher branches of knowledge and its reaction upon the lower.

12. *Conclusion.*—The above considerations are of a general character. It remains to be said, by way of concluding these introductory observations, that the Commissioners were profoundly impressed by what they saw of the excellence of much of the education, technical or otherwise, available in America and Europe. Not only is the co-ordination of every form of education carefully attended to, each class of teacher is also brought under suitable educative influences.

Recent efforts in the way of improving the technical education in Europe are, notwithstanding its present high status, more conspicuous there than in the United Kingdom. The accumulating evidence of the increase of national power directly attributable to educational advance has led the Governments of European countries to sanction an expenditure for education, which, from our standpoint, can only be described as lavish. There are cities in Germany, for example, in which the expenditure per inhabitant or per pupil is considerably greater for elementary education alone than it is in New South Wales, with its very scattered population, and the expense naturally associated with educational effort under such conditions. Secondary education and technical higher education in Europe stand in an equally favourable position. An evidence of this is seen in the fact that Germany, more than ten years ago, spent upon a single University more than was contributed by the Government of the United Kingdom to all Universities throughout the kingdom the year before last.

Such facts as these are profoundly significant, and imply that we shall do well to consider how far it is desirable to substantially increase the educational vote and to trust to the reward in national wealth through the reinforcement of that industrial efficiency arising from a more practical and more rational educational system, and from a larger educational effort.

CHAPTER II.

Various Forms of Technical and Professional Education.

[G. H. KNIBBS.]

1. *General Remarks.*—The forms of education which demand treatment at the hands of the Commissioners are Agricultural, Industrial, Technical, Art, and University education. In all of these there are at least two, and in general several, grades, and in considering their development it is essential to remember that the efficiency of the lower are, in general, largely dependent upon the existence and efficiency of higher grades.

There is a tendency which no one familiar with the educational history of our State, and competently informed as to the development of education in other countries, can fail to perceive, and to which attention should be directed, viz., for the lower forms of education to encroach upon the province of the higher. If this involved merely the improvement of the lower forms of education, it would, of course, be advantageous; as a matter of fact, however, it deflects educational effort from its proper sphere, and leads to unsuccessful attempts at higher forms of education without suitable equipment and qualification. For this reason the various *grades* of education should be carefully considered; Continental and American experience answer nearly all important questions which naturally arise in regard thereto.

2. *Technical Inadequacy of Experience in Primary Education alone.*—The Department of Public Instruction of this State was initially concerned with primary education only. It had neither to deal with, nor had it experience of, secondary nor technical education. At the present time it has important relations with the University, with the Astronomical and Meteorological Observatory of the State, with secondary education conducted directly by itself, or to some extent under its ægis, and also with certain forms of technical education.

The development of the scheme of instruction to be found in the Technical Colleges took place initially under an officer who had had absolutely no experience of technical education, and whose experience was limited to that obtained in the primary schools of the State. These were serious limitations, and although, considering them, the work has been fairly well done, it is but natural that the existing organisation of technical education should reflect the crudities of inexperience. Such traditions as were brought to bear upon the development of the Colleges were mainly derived from English technical experience, and, as already pointed out, technical education in England at the time referred to was by no means in a satisfactory condition. Neither is it now, although considerable improvement has taken place.

In any attempt to direct the evolution of our educational system, it will be necessary, therefore, to avail ourselves of the experience of countries where the organisation of education has been more competently directed, and where the co-ordination of its various elements has been determined by educationists of wide out-look. The line of progress necessarily to be followed in any rational attempt to improve our educational system involves us in first defining the aim-point of the whole educational system. That being done, we have then to make the successive changes in such a manner that they will tend toward the desired end. In this way, though our system will never be organised on perfectly ideal lines, it will be continually moving in the right direction, and will, from year to year—in fact, whenever changes are made—be adjusting itself so as to approach the ideal of a soundly organised system.

3. *Significance of the Higher Forms of Technical Education.*—To attain the end above mentioned, obviously a review must be made of the various forms of technical and professional education, but also of the fundamental differences between each of the grades in those forms. Two illustrations will indicate what is meant. A scientific agriculturist must be trained in a school which is the equivalent of a University. A practical or working agriculturist must be educated in a farming school. Although the latter carries out the actual operations by which—to take a concrete illustration—beet cultivation has been changed so that the product has increased from 5·72 to 13·00 per cent., it is to the former that the progress is essentially due. It is to the knowledge of the former, to his ability to conduct experiments, that we owe developments of such profound significance to the latter. To anyone with any knowledge of agriculture, it is self-evident that its success is dependent not upon physical labour, *as such*, but upon the intellectual elements which have come down from higher effort, viz., intellectual labour and the genius of discovery.

The second illustration may be taken from the sphere of Engineering. Although the actual parts of a modern steam-engine or of an electrical generator are fashioned by working mechanics, the efficiency of these mechanisms is to be ascribed to applications of mathematics and physics, possible alone to the professionally trained engineer. *The whole of modern progress depends upon the success with which the operations of physical labour are directed by those who are qualified in respect of higher knowledge and by a knowledge of the advance made in the sciences.* Just as the intelligent execution of physical labour is essential to its proper execution, so also is the direction of the whole plane of physical effort by intelligence and higher knowledge necessary to enable it to achieve its end. Hence it is found that countries which have carefully developed the higher educational institutions, and so organised educational effort that they react on the lower, are most successful.

4. *Forms of Education Considered.*—This report will deal mainly with the following forms of education, viz.:—

(1) Agricultural education; (2) Commercial education; (3) Lower technical education; (4) Higher technical education; (5) Higher education generally.

It is at once evident that if education is to satisfy the needs of the community in any general way, it must deal with various classes of individuals existing therein, although initially—and in fact as long as the population of the territory is small—it can hope to meet the needs of some classes of the community only in an extremely imperfect manner.

The following general review is desirable in order to bring into relief not only the wider bearings of the question, but also the consequences of the limitations to which we are subject in the initial stages of our effort to provide better technical education. The completeness of the provision for technical education in such countries as France, Germany, or Switzerland, cannot for a long time be matched in this State. But by considering a more complete state of technical education than may at present be realised, the evolution of an educational organisation can be more satisfactorily directed. Hence, it does not follow that only matters of immediate moment demand consideration; on the contrary to limit the study of education in that way would be to fail of the necessary provision.

5. *Agricultural Education.*—To be complete, agricultural education should meet the needs of all those engaged in general agriculture, forestry, arboriculture, viticulture, horticulture, farming and dairying, the rearing of horses, cattle, sheep, goats, pigs, poultry, etc. In Europe, education of this character is adapted to meet the requirements of the following classes of the community, viz.:—

(i) Farmers, dairymen, gardeners, orchardists, viticulturists and general agriculturists, horse, cattle, sheep and pig breeders, poultry raisers, etc., whose general or special education has been insufficient.

(ii) Those who intend to become engaged on the above occupations on a small or moderate scale, or who, already engaged in such pursuits, have the opportunity of devoting a portion of their time to improving their technical knowledge.

(iii) Those who own or manage large estates, and who require a somewhat higher standard of education than the foregoing, or who may desire to become instructors in the lower grades of agricultural teaching.

(iv) Those who own or manage very large estates or who wish to become agricultural engineers, professional agriculturists, foresters, instructors in the higher grades of agricultural teaching, or specialists in one or more of the various branches of agricultural knowledge.

These different grades of agricultural education are given in various kinds of schools. For example, there are school-gardens in connection with the elementary schools, in which a certain orientation of the science subjects is given in connection with primary instruction. Then there are the following types of school in which elementary agricultural education is provided, viz.:—

(1) Elementary Agricultural Instruction in Primary Schools; (2) Lower Agricultural Schools; (3) Agricultural Winter-schools; (4) Courses of Elementary Agricultural Instruction; (5) Rural Improvement Schools; (6) Special Lower Schools of Agriculture; (7) Secondary Schools for Agriculture; (8) Agronomical Institutes, or Agricultural High Schools or Universities; (9) Advanced Courses of Lectures for proprietors, managers, farmers, etc., of large estates.

These courses cover a very wide range, and the higher ones presuppose a good general education.

Some programmes are given in full in order to enable a comparison to be made between the character of the best available agricultural instruction here and in other parts of the world. (*See* in particular the chapters on the National Institute of Agronomy, France, hereinafter.)

6. *Commercial Education.*—A complete system of commercial education would be adapted to the needs of the following classes of pupils, viz.:—

(i) Those who intend to take subordinate positions in mercantile houses, or to carry on small businesses, book-keepers, clerks, etc., typists, stenographers, correspondence clerks, etc.

(ii) Those who desire to qualify for responsible positions in mercantile houses, in banks, lower grade accountants, responsible clerks (correspondence or otherwise), managers of moderate-sized commercial houses, etc.

(iii) Those who desire to have a thorough commercial education, qualifying them for carrying on or managing large commercial houses, accountants, bankers, etc., of the highest grade; or who wish to become members of a commercial *corps d'élite*, competent to deal with the highest type of commercial question.

Such instruction is given in elementary schools, and in middle and secondary schools, in what may be called secondary commercial schools, and in higher schools of commerce, or commercial academies or universities, respectively.

Some idea of the thoroughness of the work done in Europe may be obtained, when it is stated that one could gain more commercial information about Australia in the Academy of Commerce at Neuchâtel than in any one of the Australian capitals—a fact of which the Commissioners had personal evidence during their visit to that Institution. Again, in Philadelphia it is possible to ascertain not only the value of various commodities in different parts of the world but also local preferences of the goods of particular countries. And yet again it may be stated that in Europe the features of commerce in other countries are carefully dealt with.

7. *Lower Technical Education.*—Lower Technical Education embraces the education of artificers and artisans, tradesmen, etc.; that is, training in various trades and occupations, instruction in arts and crafts, in domestic economy, cooking, washing, ironing, etc., or such subjects as are included in the following incomplete list, which is given only for the purpose of illustration, viz.:—Art needlework, the lower forms of the plastic arts, baking, basket-making, bookbinding, boot and shoe manufacture, brass finishing, brazing, brewing, brickwork and brick-cutting, bronze work, building work, cabinet-making,

candle

candle and soap making, carpentry and joinery, carving, carriage-building, carving and gilding picture-frames, etc., chasing and embossing, chimney-sweeping, collotype, colour manufacture, confectionery making, coopers' work, cycle-making, diamond and jewel mounting, dressmaking, minor electrical instrument-making, electric wiring and fitting, electro-metallurgical processes, electroplating, electro and stereotyping, enamelling, engraving, french-polishing, furniture-design, furriery, gardening, glazing, glass-manufacture, goldsmiths' work, harness and trunk-making, instrument-making, iron and steel-making, jewellers' work, leather-dyeing, lithography, locksmiths' work, masonry and stone-carving, metal-plate work, millinery, moulding, optical instrument making, opticians' work, painting and decorating, paper manufacture, photography, photo-process, photogravure and similar work, plasterers' work, plumbing, pottery, press-tool making, saddlery, silversmiths' work, the work of the scenic artist, sign-writing, etc., soap manufacture, stained and ornamental glass-work, staircase and hand-railing work, tailoring and cutting (tailors'), tanning, technical drawing, tinsmiths' work, typography and letterpress printing, upholstering, varnish-making, watch and clock making, weaving, wheelwrights' work, zinc work, and many others.

Such subjects as the above are sometimes treated as independent subjects, or on the other hand they form parts of definite systematic courses.

It may be mentioned that in Russia there is a special type of school in which the education is both general and technical. The work done in these schools is excellent; but such a type of school, although the men trained therein are industrially very efficient, is hardly suited to a political organisation such as ours, which casts equal political responsibility upon every citizen. The character of the education given, however, raises the self-respect of the workmen, and is making them desirous of an extension of a progressive *régime*, and has conspicuous merits.[1]

8. *Higher Technical Education.*—Throughout continental Europe and America higher technical education is sharply distinguished from lower. The technical high schools and polytechnica of continental Europe are on the plane of the universities, and the conditions of entrance and the courses therein are substantially identical with those of a university as far as academic dignity is concerned. On the other hand an English polytechnic aims at a lower course of instruction and may be but little more than a trade school. The Massachusetts' Institute of Technology, perhaps the best technical school in America, confers degrees, and the technical high schools of Germany and Austria now confer such titles as Doctor of Engineering, etc. The character of their curricula, their intimate connection with the University ideals, their fine technical equipments, the high qualification of their teaching-staffs, and the whole atmosphere of the technical high schools of Europe, mark them off as quite distinct from the type of institution known in this State as a technical college.

The professors of a technical high school are specialists in their subjects, and their total emoluments reach the order of £4,000 or £5,000 per annum, and in Universities even more than that.

It may be mentioned that strenuous efforts are being made in England to bring the work of the higher English technical institutions on to the plane of those in France, Germany, Switzerland, etc.

9. *Concluding Remarks.*—Not only is the essential character of the work done in each type and grade of agricultural, commercial, industrial and technical education, popularly well understood in Europe, the organisation of the whole of education is such that the pupils of even the elementary school learn to recognise the significance of the higher class of work. It would be hard to overestimate the value of this popular appreciation of the higher forms of education.

It has been mentioned hereinbefore that popular ignorance in Europe formerly led, as it does in other countries, to the ridiculous supposition that there is a sort of natural antithesis between the theoretical and the practical; that theoretical efficiency was at least extremely liable to be found associated with practical incompetency: in short, that the "practical" man was to be preferred to the theoretical. This attitude of mind, which is but a reflection of that antagonism which Ignorance always feels in the presence of Knowledge, has practically disappeared in Europe, or perhaps, to speak more strictly, has disappeared as a popular shibboleth. More and more is the whole course of technical education made to depend upon *theoretical* knowledge, or, to put it in other words, the tendency is to substitute rational for empirical education, and as a consequence every effort is made to secure an intelligent outlook for each class of artificer and artisan, etc., upon his work—upon the whole sphere of his activity. A single illustration will give a more definite idea of what is meant. A woodworker, for example, in Hungary, is instructed not only in the technical details of his craft, he is also given a general idea of the morphology and physiology of plant-life, the conditions under which the timber of any tree attains its most satisfactory condition, how and when it should be felled, seasoned, how to impregnate it with preservatives to safe-guard it against decay, to stain, wax, varnish, harden, and work it up in various forms.

The character of the workmanship seen by the Commissioners in the lower technical schools left but little to be desired, and there can be no doubt that results are obtained by the method of systematic instruction which could not be achieved in anything like the time, if at all, under the old system of apprenticeship.

The chapters following hereinafter will disclose, often with considerable detail, the character and scope of the various courses.

---

[1] It is easy to give a practical orientation to elementary education without destroying its value, provided that a properly trained and educated teaching staff is available.

CHAPTER III.

CHAPTER III.

Apprenticeship in relation to Education.

[G. H. KNIBBS.]

1. *Introduction.*—As soon as one passes from the consideration of *general* education to those forms which are designed to qualify for *special* callings or occupations, the question of the proper place of apprenticeship as a necessary or desirable feature in practical instruction must be entertained. In times past the method of obtaining such practical instruction, at least, for all kinds of trade and technical occupation, was limited to apprenticeship. In many of the higher professional callings, as for example, in medicine and surgery, notwithstanding that they involve that special skill which is acquired only by actual practice, the apprenticeship system has long been abandoned; and it is rapidly disappearing in others, as, for example, in engineering. Further, it is already widely recognised that it may also with great advantage be abandoned, even in trade occupations, such for example as carpentry, cabinet-making, bricklaying, masonry, etc., etc.

From time to time one hears the allegation, not unfrequently from those whose theoretical or systematic education has been of the most meagre character, that the abandonment of the essentially "*practical*" education acquired through apprenticeship can only lead to marked inferiority. It is also sometimes alleged that the theoretically (or rather systematically) trained man is less useful in actual life; that he is unpractical.

On the other hand, those who have been systematically trained, and many also who have not, point out, that in the ordinary apprenticeship system, the usual aim is to make good workmen in whatever section of work may happen to suit the immediate interests of the master or proprietor; in fact, ***the educative element has to be either entirely, or at least largely, subordinated to the proprietor's business interests,*** and that there is no system or method in the apprenticeship scheme of educating practical workers. The knowledge is simply "picked up."

In some cases this defect has, to a limited extent, been overcome by a method of passing apprentices regularly from one class of work on to another, and in others the apprentices have been required to obtain regular theoretical instruction during a stated number of evenings. In other cases again, students receiving purely theoretical instruction for a portion of the year are required to spend their vacations or balance of the year in actual practice in a suitable working firm.

All mere apprenticeship must necessarily be somewhat unsystematic. On the other hand, the opportunities for practical experience are essentially somewhat limited in trade and technical schools, which have necessarily limited outfits and equipments. Here lies the crux of the question. In what direction does the experience of the world, taken as a whole, point in regard to the highest efficiency? How far, in other words, may systematic technical instruction be developed so as to dispense with the system of apprenticeship?

2. *Apprenticeship and Systematic Instruction.*—As already implied, even the most ardent advocates of apprenticeship in its best form cannot for a moment claim that it proposes to *thoroughly* educate the apprentice, much less to conserve his time. It does not aim at making him efficient in the shortest possible period; hence from the individual point of view, as well as from that of the State, *the apprenticeship scheme is an economically defective one.* In most businesses, the educative point of view is necessarily abandoned; everything turns on the exigencies of the moment, and the business interests of the employer or master; a fact which cannot be allowed much weight in any State scheme which aims at the best possible preparation of its citizens for their life work.

Industrial and technical efficiency, if acquired early and well, is so much gain to the wealth-producing power of the State, and this fact must be the determinant element of the State's attitude in regard to technical education. The natural disinclination of most enterprises to materially assist competition cannot be allowed any weight at all.

All technical operations when reduced to their elements involve processes which can be learnt in a regular way. Hence an establishment for technical teaching, while it cannot be equipped on a scale comparable to that of a great manufacturing one, can, nevertheless, have *every essential feature for complete instruction*, so that the *principles of all operations may be thoroughly understood*, and so, also, that manual dexterity may be fairly well developed. And this is its great advantage. It can pass each student through a far wider range of elementary experience, so that his thoughtfulness, adaptability and general resource shall be altogether more highly developed.

Thus France and Germany qualify its workmen in textile industries in "Weaving schools;" Switzerland, its watch and clock makers in "écoles d'horlogerie"; the whole of Europe has schools for tradesmen, where they learn their trades excellently and very quickly, "Fortbildungschulen," "Gewerbeschulen," "Ambacht scholen," etc.

Not only can the exercises be so graduated as to be of the highest educative value in the systematic method, but suitable theoretical instruction can be given, so that the practical and theoretical work are collateral or, rather, are educatively co-ordinated.

In some parts of Europe provision is even made for practical experience in business establishments in the case of students of engineering, and students from the technical high schools spend a part of their time in doing suitable practical work in actual workshops. In many cases they are fairly liberally paid during the time they are undergoing this practical education, and the more liberal firms are beginning to recognise that their highest interests are not served by demanding large premiums.

This

This method of alternating periods of theoretical and practical instruction is, in some cases, the most advantageous of all; especially where the equipment of laboratories cannot be developed on a sufficiently large scale. *If, however, the equipment of a laboratory can be made adequate, better results can probably be got by carrying on the theoretical and practical parts of the instruction collaterally.*

3. *Manual training and Technical Instruction.*—When the Sloyd scheme of manual training shall have become general, very little difficulty will be experienced in rapidly qualifying artisans by means of continuation-schools for their various handicrafts. This is a consequence of the *manual dexterity that will then have been acquired during the career in the primary school.* In this case, however, the whole of the preparatory education takes place in the primary school, and the attention is wholly devoted to the acquisition of skill in the particular trade or calling under consideration. There is no difficulty in this particular direction; the difficulty arises only when one comes to deal with the trades or callings involving theoretical instruction beyond that given in the primary school, and which demand at the same time the development of the craftsman's skill. The whole matter will come into clearer relief by discussing some elements of practical experience of the apprenticeship method and of its modifications.

4. *Apprentices in the United States.*—Cassier's Magazine for November, 1902, was a special issue known as the "machine-shop number." It contains two important articles: one on experiences with apprentices in the United States, and the other on experiences in Great Britain of the same character. It is clearly recognised that the conditions under which industrial operations take place to-day are materially different from what they were when smaller establishments were in vogue. The great advantage of the old apprenticeship system in its first form was that, when the master was a man of skill and character, the boy was influenced by his personality in a favourable way; but in a way which is now impossible—because of the size of the establishments and their strenuousness. Under the present conditions the régime is less personal and therefore more mechanical. In the article by Mr. E. S. Parks, M.E., of the Brown and Sharpe Manufacturing Company, he states that "the technical schools have in a measure attempted to supply the lack of skilled workmen"—that is to say, such workmen as were educated under the old régime; but, he says, "the results, while excellent in many ways, do not bring out the class of men with the training and experience needed, so that at the present time it seems as though there were but one way to fill this want—that is, *by returning to the old apprenticeship system as nearly as it can be done in a large factory.*" It is admitted that it is impossible for the apprentice to be brought into close contact with the head of the establishment any more than it is possible for each student in a very large institute of learning to be brought into contact with its director. Mr. Parks refers to the practicability of a competent instructor being profitably employed in attending to the instruction of apprentices. His words touching this matter may be quoted in detail:—

"This instructor can see to it that proper selections are made from the applicants; that they are given correct instruction in the shop; that they are changed about from department to department as time progresses; and he should be a man of character, to whom the boys can go for advice and counsel, and who can look out for them in the many ways that will occur to anyone who is duly qualified to take charge of apprentices. A man qualified to fill such a position should be a man of executive ability; should have a good knowledge of human nature; understand the mechanical work that is being undertaken by the boys, and have a patient spirit and gentlemanly bearing. And, above all, he should be thoroughly sincere; otherwise he cannot command due respect from the boys whom he is to guide. With the supervision of such a man it is possible to bring up young men who will be properly educated in the business, and not only fitted to do the ordinary work of the shop; it will furnish foremen, and those who may eventually become managers." (pp. 199-200).

Mr. Parks made a special inquiry into the various systems of handling apprentices, and he states that there is a complete lack of uniformity among the different manufacturers of the United States. Some apprentices are hired in the same way as ordinary workmen; there are no agreements, and they are apprentices but in name. In other cases, however, apprentices are given a thorough education in the details of the work of the firm employing them. The following table of results is instructive, as a study of them will shew:—

Apprenticeship Data from 112 *Shops.*

Character of Articles manufactured.	Number of factories.	4-year Apprentices.	3-year Apprentices.	Apprentices without system.	System of apprenticeship abandoned.	Hire boys—no agreement.	Information complete.	Indenture or written agreement.	Pay bonus.	Require deposit.
Machine tools	41	25	8	4	2	2	0	21	18	5
Engines (all kinds), pumps, etc.	37	21	4	6	1	3	2	17	13	1
Electrical machinery, and miscellaneous	34	10	5	7	3	7	2	11	9	1
Total	112	56	17	17	6	12	4	49	40	7

Among the apprenticeship systems examined, that of the Baldwin Locomotive Works was deemed to be the best. The apprentices are graded, the class to which they are assigned depends upon their previous education. This, it is admitted, is suitable only for large shops. For small shops, Mr. Parks believes in the four years' course of apprenticeship. In the latter, after a preliminary trial, the lads are expected to pay 50 or 100 dollars, say, £10 to £20, for the privilege of learning their trade, which is suggested should be returned upon completion of apprenticeship, together with a bonus of 100 dollars, in addition to any wages paid during the term, it being supposed that the wages during the last year are sufficient for their keep.

5. *Details of the Baldwin Apprenticeship System.*—The plan of apprenticeship in the Baldwin Locomotive Works was drafted by Mr. N. W. Sample, and since these works employ over 10,000 men, their experience is of some value. The apprentices are divided into three classes, special prominence being given to educational qualification in the first two classes, while a third-class provides training for technical school graduates. There are nearly five times as many apprentices in the first two classes combined as in the third class. The following quotation from Mr. Parks' article will afford information as to the régime for these classes:—

"The usual legal form of indenture is followed for the first two classes. The first class requires four years' service, and the age limit is placed so that the boys will finish at the age of twenty-one years. It is expressly stipulated that the apprentice must 'faithfully attend at least two evenings in each week during the first three years of his apprenticeship free night-schools, such as during the first year will teach him elementary algebra and geometry, and during the remaining two years will teach him the rudiments of mechanical drawing. . . . . It is understood that the apprentice already has a grammar-school education, or sufficient to render it unnecessary that any provision should be made for his further instruction."

"The second class requires three years' service, and requires an advanced grammar or high school training, the upper age limit being eighteen years. During this service the apprentice must 'faithfully attend at least two evenings in each week during the first two years of his apprenticeship free night-schools which will teach him the rudiments of mechanical drawing."

"All three classes are to be moved or changed in the shop, the first two classes every three months, and the third class at their own request, subject to the approval of the superintendent. In order to arrange the moving systematically, and to keep a complete record of the work, the conduct, and character of service of each, a blank form is used, a portion of which, the section for the first year, is reproduced here. These blanks, when completed, contain the record of each apprentice for his entire service, together with every foreman's opinion of him."—(p. 222.)

BALDWIN LOCOMOTIVE WORKS.

Apprentice Record.

Name.................... Age........ ... years........... months.................Address..................... ....
Class........................ Date of Indenture..................................... 19... Shop................................

First Year.

Time.	Expires.	Employed on.	Services were.	Conduct.	Rate per hour.	Sign. of Foreman.
1st 3 months	....	....	....	....	....	....
2nd 3 months	....	....	....	....	....	....
3rd 3 months	....	....	....	....	....	....
4th 3 months	....	....	....	....	....	....

Remarks.

....

NOTE.—Apprentices will be changed from one machine or job to another once every three months. Apprentices must not be transferred from one department to another without consultation."

The whole question of future employment of apprentices is determined by the need of the Company and the personal record; and any apprentice whose faithful study and evident value justify it, may be passed to the third or technical class. There is a general understanding that at the end of the training, the apprentice's position will be that which his records warrant.

6. *The Brown and Sharpe Manufacturing Company Apprenticeship System.*—The system of the Brown and Sharpe Manufacturing Company has been in vogue for more than thirty years. As regards age, the admission is confined within the limits of from 16 to 18 years of age, and the entrance requirements are as follows:—

(i) Candidates must be physically sound.
(ii) And must be of good moral character.
(iii) They must have received an education at least equivalent to that required for graduation from the Public Grammar Schools of the City of Providence.
(iv) Application must be made in person.
(v) The first 480 hours of service shall constitute a probationary period.
(vi) If probation be satisfactory, an agreement must be entered into for four years, each year to consist of 2,950 working hours.

A point worthy of notice is that the graduates of the Providence Training High School, if well recommended by its Principal, may have their term of apprenticeship shortened at the discretion of the Company.

Apprentices are paid for each hour of *actual* service at the following rate:—

1st year.	2nd year.	3rd year.	4th year.
6 cents.	8 cents.	10 cents.	14 cents.

This maximum amount of 7d. per hour seems very small; but it ought to be remembered that the Company faithfully instructs the apprentice in the machinist's art and trade during the term of apprenticeship, and it stands in strong contrast with the action of firms who charge a heavy premium.

7. *Apprenticeship System in the British Royal Dockyards.*—In the magazine previously referred to appears also an article by Mr. F. Barter, a member of the Institute of Naval Architects. In commencing his article, Mr. Barter says:—

"The alleged decline of industrial supremacy has in recent years engaged the anxious attention of the people of Great Britain, and her foreign competitors have derived considerable satisfaction from the existence of such a belief. Two reasons have been persistently advanced as mainly contributory to this state of affairs, namely, the evil influences of misguided trades unionism, and the faulty methods practised in educating the workers in technical matters. *Perhaps it would have been more correct to say the absence of any method at all.*"—(p. 205.)

Mr.

Mr. Barter points out in the clearest possible terms what may be called the natural limitations of an apprenticeship to a business firm. His remarks are so significant that it is desirable to quote them *in extenso* :—

"In the private shipyard or engineering works *the apprentice is regarded by his employers mainly in the light of a profit producer*, and in return for his services as such he is permitted to learn the business up to the point of making a workman of himself. In the royal dockyard, on the other hand, the apprentice is regarded in the light of a student as well as a "trade" apprentice, and he is educated by the government in both senses. Practically unlimited facilities are afforded him for the acquisition of the most useful education obtainable—scholastic as well as technical—the object and hope of the Admiralty being, of course, that they will be able to retain in their service those who have benefited most by such facilities."—(p. 205.)

The writer points out that the additional advantages enjoyed by what are called "premium apprentices" in private establishments are usually of a merely departmental character; they go through the various departments, but *are practically left to their own resources and inclinations as regards educational study.* A youth who would become a shipbuilder must spend a portion of his apprenticeship in the various trades of shipbuilding, and he has to pay a premium varying from £50 to £750; similarly in engineering. If he wishes to learn the subject in any complete sense he must pay a heavy premium. If he cannot do this, he must rest content with being an engine-fitter, turner, pattern-maker, boilermaker, coppersmith, or a draughtsman. The apprenticeship in the Royal Dockyards involves no premium, but merely the passing of a medical examination and a pass in the following subjects, the first three of which are compulsory and the remainder theoretically optional:—

(i) *Arithmetic*, as taught in the public schools, cube root being excepted.
(ii) *Orthography.*—The two selected pieces of dictation to be written in a given time.
(iii) *Writing.*—A paragraph containing a tabular statement of statistics.
(iv) *Geography.*—The world, special stress being laid upon Great Britain and her Colonies.
(v) *English.*—Analysis, syntax, etymology, etc.
(vi) *English composition.*—Moderate proficiency only is required.
(vii) *Algebra.*—Up to and inclusive of simultaneous and quadratic equations.
(viii) *Geometry.*—Books I to III of Euclid with deductions.

Successful candidates are permitted, in the order of merit, to choose to some extent their profession, and are each assigned an instructor, who for the first four of the six years of apprenticeship receives an extra two shillings per week. The apprentice binds himself not to be absent without leave, not to marry during his indenture, not to be guilty by word or action of any immoral, indecent, irregular, or improper conduct or behaviour in any respect, etc., etc.

The first four years are spent in constant companionship of the instructor, the remaining two years with any mechanic nominated by the inspector, and the range of practical experience is from the preparation of blocks for receiving the keel of a vessel to its finishing sea-going condition.

Evening classes are conducted by the chief-draftsman in the dockyards drawing offices, attendance being *optional.* A year's attendance gives a right to selection for six months' day-instruction in the drawing offices, and apprentices with special aptitude are often specially retained in the drawing office ("borne out on drawing duties"). They receive appointments when vacancies occur, after passing a competitive examination in practical and theoretical naval architecture.

The above applies to the shipbuilding department, but the engineering department has the same régime.

Each dockyard has a library and school. Apprentices of 1st and 2nd years constitute the lower division, those of 3rd and 4th years the upper division. Each division attends school for two afternoons and evenings a-week for *general study*, and one evening for science lectures and laboratory practice. Text-books are supplied by the Admiralty. Examinations are held every six months and last from three to six days, and indolent apprentices and those who do not attain 40 per cent. of marks are not allowed to continue. The subjects are as follows:—

Lower Division (1st and 2nd Year).

Arithmetic and mensuration ...	400 marks.
Algebra ...	400 "
Geometry (Euclid's Books I to VI, XI, and XII, with deductions)	500 "
Trigonometry ...	500 "
Statics and hydrostatics	600 "
Physics (light, heat, magnetism, and electricity)	600 "
Chemistry	300 "
French (optional)	400 "
Geography and English history	400 "
Total	4,100 "

Upper Division (3rd and 4th Year).

Statics, hydrostatics, and hydraulics ...	500 marks.
Dynamics	500 "
Applied mechanics	500 "
Higher algebra and trigonometry and elementary conic sections	500 "
Differential and integral calculus and conic sections	700 "
Descriptive geometry (or mechanism)	400 "
Physics (light, heat, magnetism, and electricity)	700 "
Chemistry	400 "
Naval architecture (or engineering)	2,400 "
Total	6,600 "

Final

Final Examination (end of 5th Year).

General paper in elementary mathematics and mensuration	500	marks.
Statics, hydrostatics, and hydraulics	500	,,
Dynamics	500	,,
Chemistry	400	,,
Physics ([a] heat and light; [b] magnetism and electricity) ...	700	,,
Applied mechanics and graphical statics	500	,,
Descriptive geometry	400	,,
Advanced algebra and trigonometry	500	,,
Conic sections, and differential and integral calculus...	700	,,
Practical physics	300	,,
Heat, combustion, and metallurgy	800	,,
Practical Shipbuilding—Part I	1,000	,,
,, ,, Part II...	1,000	,,
Shipyard machinery—Practice and appliances...	600	,,
Ship drawing	600	,,
Laying off and mould practice	1,000	,,
Total	10,000	,,

In the place of descriptive geometry and the last five subjects of this list, engineer students take:—

Theory of mechanism and machinery.
Steam and the steam-engine.
Practical engineering.
Workshop appliances and practice.
Mechanical drawing.
Design of machinery.

The best two or three of the 4th year apprentices go to the Engineering College at Devonport to continue study for the fifth year. Those who pass the "final go" to the Royal Naval College at Greenwich, to continue their studies; obtaining 75 per cent. in the upper division examination gives the right to claim all text-books, value nearly £20.

A testimony of interest is that "most lads of ordinary intelligence *will learn more of their business during the fifth and sixth years than during their first, second, third and fourth years put together.*" It may be remarked that these are the years of technical study.

8. *Apprentices in British Private Establishments.*—It is said that "the private shipbuilding and engineering establishments of Great Britain, speaking generally, take little interest in the technical education of their apprentices," and that they "cannot be expected . . . . . to put themselves to the expense of educating their apprentices as thoroughly as the Admiralty does." And, further, Mr. Barter says:—

"There is no doubt that much of the existing pessimism as to loss of commercial prestige with which Great Britain seems to be threatened would be removed if shipbuilders and engineers would take more interest in the intellectual welfare of their apprentices; or, for that matter, their employees generally. When this happens, employers will find it as much to their profit as to their credit."

There are signs of promise, however. The Technical Instruction Committee of the Corporation of Manchester issued a pamphlet in July, 1900, on the scholarship scheme of Messrs. S. Z. Ferranti, Limited, Electrical Engineers, of Hollinwood, near Oldham, and this movement merely expresses a growing recognition of the necessity of *really thorough* technical instruction.

The following extract from the pamphlet referred to, by F. Brocklehurst, M.A., indicates the scheme:—

"In the first instance the firm undertakes to move selected apprentices from one department to another in their works, including the drawing room. The selection of these apprentices is to depend upon their success at evening classes, combined with the recommendation for attention and steady work given by their foremen. In the second instance Messrs. de Ferranti offer for competition amongst their most capable apprentices a Day Scholarship at the Manchester Municipal Technical School. This will be awarded to the apprentice who, being not more than 19 years of age, obtains the highest position in the Science and Art Examinations of any given year, in a selected number of subjects which are of importance to the adequate theoretical training of an engineer. The fees of the scholar whilst in the day engineering department of the Municipal Technical School will be paid by the firm, and they will also pay him his wages at the standard rate corresponding to his age. His continued enjoyment of the scholarship will depend upon satisfactory weekly reports of progress, and with the purpose of maintaining his close touch with his trade, the apprentice-scholar will be required to work in the shop on all occasions of school holiday which are not works holidays."

Mr. Brocklehurst remarks:—

"Such are the main outlines of a scheme which, if it were universally adopted by employers, would, I make bold to say, completely revolutionise the relations between capital and labour, educate and elevate the character of the entire working-class population, and transform and modernise our methods of industrial production."

It is pointed out that *the technical schools do what the modern apprenticeship system fails to do, viz., enable men to discharge the far larger range of duties demanded in modern industrial activity.*

In this connection may be mentioned the action of Messrs. William Denny and Brothers, Shipbuilders, Dumbarton. They *refuse premiums, preferring apprentices with brains rather than those with money.* The evening classes in Science and Art at Dumbarton are largely subsidised by this firm, and apprentices are encouraged to attend, the fees being merely nominal.

Another

Another feature to which attention may be directed is the tendency to ask for higher preliminary education. Mr. Brocklehurst says:—

"Messrs. de Ferranti are not alone in their endeavours to raise the mental and moral efficiency of their apprentices. Messrs. B. and S. Massey, of Openshaw, are, I understand, willing to encourage the sons of working men to stay at school until they are seventeen years of age, by offering to accept them as apprentices at that period at the wage they would have obtained had they begun at fifteen. They ask that the boy shall first of all possess a good general education, and then gain a technical scholarship at the age of fifteen, which will give him free tuition at the technical school and an income of seven shillings per week during the next two years. . . Let me for the moment suggest to employers the enormous powers they possess, and which, if exercised intelligently, would effect beneficent and far-reaching changes in every department of industry. Boys are plentiful in Manchester. Then why are employers content with inferior material? Let them insist upon an educational standard for their apprentices, and parents will soon see that their children conform to it. If, for example, a few of the leading firms of Manchester would refuse to allow a lad to enter their warehouses who had not passed through a higher elementary school, or attended technical instruction or commercial classes, they would attract the best of the youthful talent in the city; and the other employers, growing dissatisfied with the inferior leavings of the big firms, would also speedily adopt this educational standard."

9. *Apprenticeship in Europe.*—Systematic technical instruction is given to young people in Europe after they have passed through the obligatory period of primary instruction. In some instances they qualify before the period of apprenticeship, and the more readily find employment; in others, they are apprenticed and attend "improving," continuation, or trade schools in the evening. It is no uncommon thing to find attendance at evening schools obligatory for several years after the obligatory period for primary education.

All types of technical schools seen by the Commissioners in Europe are excellently equipped and well staffed. Their evident aim is to thoroughly prepare the students for their life occupations, so that they may work skilfully and intelligently; and it is impossible to examine recent workmanship without recognising that this has borne fruit.

The equipments are often on a very large scale, and the work done even by young students unexcelled by older tradesmen.

Not only is practical work demanded of those whose callings are trade-callings, but a similar demand is also made in the case of those who desire to prepare themselves for such professional occupations as engineering in its various branches. This leads to excellent results, and enables the student to rapidly reach the plane for which his abilities qualify him. An illustration of the method is given hereunder.

10. *Practical Experience for German Engineering Students.*—Germany is realising the advantage which accrues from having the professional engineer thoroughly informed practically. Many engineering firms, *responding to the national desire to attain to great industrial strength*, have made the conditions under which students may acquire practical experience exceedingly liberal. The following example may be taken as an illustration.

In the Charlottenburg Hochschule, students in engineering are required at some time during their course to do certain practical work outside the Hochschule. It is immaterial whether this work is done during the course or at its end, but each student must produce evidence of having done this work before he can enter for his final examination.

This is arranged for in the Charlottenburg programme by having two substantially identical courses each year—one in the summer and the other in the winter Semester. Students are, of course, not compelled to attend *both* courses. Those who wish may devote themselves to the outside work, say, during the summer Semester, and attend lectures in the winter, or *vice versâ*.

Assuming that a student desires to proceed with his outside work, he applies to his Professor for a recommendation to some works. Most firms prefer students who have completed their lecture courses, but that is not essential. Should the student's application be accepted—he may, of course, have to wait until a vacancy occurs—he is taken on as a regular employé, and paid a regular salary. *No premium is required.* The student, if giving satisfaction, may, as a rule, remain as long as he pleases; usually, a month's notice on either side cancels the agreement. In other words, the students find employment in the large works, and their success or failure depends entirely upon themselves.

The engineering, electrical, and similar firms in Germany give preference to Hochschule students; this, together with freedom of choice as regards all but elementary subjects taught in the Hochschule, gives each student the opportunity of following whatsoever branch of engineering he prefers.

The liberality of the German firms in meeting the need for practical training may be illustrated by the case of a graduate of the University of Sydney, who says, in a letter to the Commissioner:—

"You will remember that Professor Warren, when visiting Siemens and Halske's, made arrangements for me to enter their works at 4 marks (4s.) per day. In order to indicate how anxious they were that I should learn as much as possible in the shortest possible time, I may mention that at first I was employed in the test shops for eleven months. Here all kinds of electrical machinery had to be tested, and in some cases new types or designs were exhaustively examined. From this thoroughly practical department I was transferred to the central station design office, and, to use Siemens and Halske's own words, was entrusted with the design of central stations of all kinds, both for home and abroad. From this department I went into the department for the application of electricity in all its branches, and, after about two and a half years, was sent to Australia."[1]

Many firms endeavour to educate even their office boys. They are encouraged in every way to attend evening schools, the firm even providing a library, from which they can obtain both elementary and advanced text-books, for use during any spare time they may have in office hours.

All the technical journals, as well as standard text-books, in English, French, and German are available for each employé, he having merely to sign a paper requesting that the journals *be brought* to him once a week, say, and to give a promise to return them within a certain time in good condition.

It

[1] The Commissioners desire to express their hearty thanks to Mr. B. Wallach, B.E., Sydney University, formerly representative of Siemens and Halske. Also to Prof. Geh. Reg. A. Martens, Prof. Geh. Reg. A. Riedler, Prof. Rudeloff, Prof. Dr. Witte, Herr Burchartz, and to many members of the Professorial Staff of the Technische Hochschule, Charlottenburg.

It is important to understand the reason of this. Germany has clearly recognised that national power, and, in the larger view, the progress of her citizens, depend upon her attitude to education. The more important firms, fully seized of this, respond in a liberal way to the needs for practical education by supplementing that given in the modern laboratory and lecture room by such experience as may be had in the larger industrial works.

It would be a mistake, however, not to recognise that, in keeping with the practice in Belgium, France, etc., thorough technical training is provided in the lower grades of effort, that is for artisans of all kinds. This is done very largely in the various forms of schools for the different trades.

11. *Swiss Complementary Schools.*—The recognition throughout Switzerland of the necessity of substituting systematic instruction for the older forms of apprenticeship is very wide spread. Each canton, it is true, has its own system. In some cantons attendance at the "complementary" schools (les écoles complémentaires, Ergänzungschulen), is *optional*, in others, *obligatory*. For example, in Fribourg this obligation is from 16 to 19; in Soleure (Solothurn) it is from 15 to 18. In some cantons, where the primary obligation terminated at 12 years, the children attend the complementary school from 12 to 15, that is, while they are in their apprenticeship; in others again, as at St. Gall, from 13 to 15.

In many commercial houses the ordinary term of apprenticeship is three years, but everywhere a willingness is shewn to shorten this term in the case of those who have received a thorough technical mercantile education. In fact, it is not uncommon for those who have passed their course successfully in such schools to receive positions carrying satisfactory salary without undergoing any term of apprenticeship whatever.

12. *Russian Practice.*—In St. Petersburg the same attempt to educate the artisan both generally and practically was seen by the Commissioners. No one could fail to realise the immense advantage which students so trained had over those educated by apprenticeship to the ordinary tradesman. In fact, the work seen in St. Petersburg, in actual progress, was unsurpassed.

13. *General Conclusions.*—Although throughout the United Kingdom there are still many industrial and mercantile establishments and other organisations which espouse the old empirical forms of education, rather than modern systematic technical education, and who endeavour to maintain the old apprenticeship system, the effort of the nation is clearly trending in the opposite direction. As to the exact line of delimitation between the theoretical and practical needs, there is, of course, still difference of opinion, and, therefore, the apportionment of time to each side will be found to exhibit some variety.

In general, one finds that men, whose theoretical education has been limited, if not decidedly antagonistic to theoretical training, are disposed to depreciate its value; and this is true, whether one looks to the professional ranks (engineers, architects, etc.), or to the ranks of tradesmen. The reason is not far to seek, and the testimony of such people cannot be allowed weight in comparison with the testimony of those who have had the advantage of both theoretical and systematic instruction, and whose reputation for practical ability is also beyond question. The latter *are uniformly advocates for the substitution of systematic for unsystematic methods of technical education.*

An examination of the intrinsic advantages of the systematic methods will make it impossible to suppose that the old apprenticeship methods of tuition can possibly claim equal excellence.

The teachers in the technical schools of Europe and America are men not of average but of superior ability in their own walk of life. In virtue of their calling as educationists, in virtue of the range of study of their subjects, and in virtue of some appreciation of the inter-relations between their own work and that of others, they have a far wider horizon than the ordinary artisan, tradesman, or the uneducated engineer.

Not only were they, in the first instance, specially selected for their teaching capacity and practical competency, they are also, in properly equipped schools, provided with suitable teaching material. Further, they have opportunities for systematically using this for illustrating technical operations and processes, for making such experiments as may seem desirable, for testing students' capabilities, and so on. Thus they are able to bring about a concentration of the student's effort, impossible in apprenticeship. This is another feature which proclaims the higher excellence of the systematic methods of modern technical education.

In a recent address[1] by Professor Victor C. Alderson on the necessity for this, that gentleman, addressing Americans, said:—

"The Germans are fully alive to the necessity of being well prepared to engage in the struggle for industrial supremacy. Prince Bismarck once said: 'The war of the future is the economic war; the struggle for existence on a large scale. May my successors always bear this in mind, and take care that when the struggle comes we are prepared for it.' Bismarck's behest has been heeded. The Germans, by dint of long and thorough preparation, are ready for an economic war. For more than thirty years they have been preparing, and we can see in all directions the steps that have been taken to improve the technical sides of education, so as to produce men who are capable of carrying Germany to the front in this industrial and commercial struggle. . . . . . These schools are all beautifully housed, have superb equipments, and are doing a high grade of professional engineering work. Next below them in educational rank comes a great number of trade schools, like the textile school of Crefeld. These trade schools are located at the centre of the industry to be benefited, and are distinctly utilitarian in character. Besides these, there are many continuation and manual training schools. So numerous are these specialized schools that *a German can always find one in which he can learn the latest and best principles, devices, and methods of any trade or profession he may desire to follow.* Add to all these the latest German innovation of commercial high-schools and colleges of commerce, then wonder, if you can, why German competition is so keen, and why German trade and industry are reaching every market the world over. *The Germans have discovered that the secret of success in trade and industry depends upon education;* not upon the education of the library and cloister, but upon the education of the laboratory, the shop, and the modern lecture room."

What

[1] 20 October, 1902, at the Chicago Literary Club.

What the Commissioners saw during their travels in Europe justifies them in saying that such statements are not exaggerated. It is worthy of remark that Americans, in all branches of technology, regard Germany as one of the most important places to visit in order to keep abreast of modern technology, and Germans, also, visit America for the study of American methods and ideas.

The whole evidence is unmistakeably against the desirableness of in any way supporting the old system of trade or professional apprenticeship, and entirely in favour of the substitution of systematic technical education in its place.

Thus, good teachers—i.e., not mere craftsmen, but professional teachers with the necessary practical knowledge—with good technical laboratories, and well organised curricula, are essential, if we are to hope to be the industrial and commercial peers of the great countries in the opposite hemisphere.

Whatever abstract doubts may remain would be dispelled by seeing the character of the work done, and observing the whole scheme of technological training.

The essentials of practical ability in industrial occupations, and in the various trades and callings, are systematic training of eye and hand. The sense of form must be developed, the artistic sense, the manual skill, the knowledge of practical detail.

The evidence is that the modern tendency is overwhelmingly in favour of substituting systematic education for ordinary apprenticeship. To be adapted to practical requirements, and to assured success, technical education must have regard to the following:—

(1) General instruction, orientated when and where ever possible, so as to make it specially serviceable to each trade or calling, or to disclose its application to the practical calling.
(2) Skill in drawing and designing.
(3) Skill in modelling (where necessary).
(4) A thorough knowledge of the rationale of the details of craftmanship, so as to substitute rational methods and readiness to change for rule of thumb methods and trade-conservatism.
(5) Practical knowledge of artisan methods, of the conditions imposed by the physical and other limitations under which practical work is executed, in fact of working methods and conditions.

It is at once obvious that technical schools with systematic instruction, with properly fitted workshops and laboratories can afford advantages never to be found in the work seen by the ordinary apprentice.

If, further, the proprietors of factories and workshops will assist as in France, Germany, Russia, etc., the last limitations of the systematic instruction of students and apprentices will disappear. The report will establish this truth.

CHAPTER IV.

CHAPTER IV.

The National Urgency of Better Technical Education.

[G. H. KNIBBS.]

1. *Introduction.*—Technical Education, to fulfil its function in any community, must, as pointed out in Chapter. II, meet the needs of all classes of industrial workers and of those charged with the professional and scientific control of the industrial operations carried out by them. To provide instruction for the training of the more numerous class, viz., the workmen, artisans, etc., is not sufficient; it must extend to the highest planes of human effort—it must qualify for that guidance without which the actual labourer's efforts cannot achieve their end. The latter class are of course relatively small in number, but their education is of the very highest importance.

In this connection it has to be remembered that in our productive activities we are in competition —*necessarily so*—with all the civilised races of mankind, and ultimately our very national existence depends upon the excellence and wise direction of our wealth-producing powers.

It is only from this point of view that the tremendous significance of general education, and its complement technical education, fully appears.

It is necessary to remember also that from the lower to the highest grades of technical development we are dependent upon the preparation which takes place in the kindergarten, and in the primary, or primary and secondary schools, according to the age at which the departure from general to technical education is made.

2. *Our National Position in Technical Education.*—No one with any knowledge of the technical provision made in the United Kingdom for technical education can regard the provision made in this State as correspondingly complete. When, therefore, what is done here is compared with technical education in Europe it is, to borrow an expression quoted hereinafter, relatively "*nowhere*," notwithstanding the fact that it has been considerably advanced during the last few decades. That is the point we want to keep before us in facing the issue of educational reform in so far as it applies to technical education.

This necessity for better technical education, and indeed also better general education, has recently given every thoughtful Englishman who has any capacity to look out on the national future the *deepest concern*. There is a thoroughness in the scientific and technical work of Europe which is lacking here, and lacking also in England.

Not only are educational equipments better in Europe; the qualifications of the instructors are also much higher than with us. This is no doubt the fruit of their systems rather than the consequence of any natural superiority of intellectual and moral endowment. We shall miss the main point if we fail to recognise, however, that it will take strenuous effort for a very long period to reach anything like the degree of excellence which technical education has acquired in European countries generally.

It is the vivid recognition of this fact that has forced such men as Lord Rosebery, Dr. R. B. Haldane, and others to refer to our national educational attitude in language which savours almost of the *alarmist*; and be it observed that responsible committees are no less *disquieting* in their utterances. An example may be had by reference to the deliberately expressed opinions given hereunder.

The London County Council, in connection with its Technical Education Board, appointed a special sub-committee to investigate the whole question of education in relation to its application to science and industry.[1] That committee brought forward evidence of calamitous loss of business and falling off in industrial efficiency through national negligence of general and technical education. The committee had the evidence of the ablest men of England—men who are familiar with Europe, who are in many cases intimate with the leading members of the teaching-staffs of European Universities and European technological establishments, and who are also linguists, and who have, therefore, really come into direct touch with European sentiment and tradition.

Some of the witnesses were the following:—

J. W. Swan, Esq., F.R.S. (Electrical Engineer; President of the Society of Chemical Industry).
Sir Bernhard Samuelson, Bart., F.R.S.
Sir Henry Roscoe, F.R.S. (Vice Chancellor of London University; Emeritus Professor of Chemistry, Owens College, Manchester).
Dr. Frank Clowes (Chemist to the London County Council; Emeritus Professor of Chemistry, University College, Nottingham; President of the Society of Chemical Industry).
Professor James Dewar, F.R.S. (Professor of Chemistry at the Royal Institution and Director of the Davy-Faraday Research Laboratory; President of the Society of Chemical Industry).
Dr. J. T. Merz (Chemical Manufacturer, Newcastle-upon-Tyne).
Dr. W. H. Perkin, F.R.S.
Professor Sir William Ramsay, K.C.B., F.R.S. (Professor of Chemistry, University College, London).

Thos.

[1] Although this was some little time back the dicta are none the less important. It should be remembered also that the scheme of technical education in New South Wales was organised on English lines.

Thos. Tyrer, Esq. (Chemical Manufacturer, London; President of the Society of Chemical Industry).
Professor Meldola, F.R S. (Professor of Chemistry, Finsbury Technical College).
George Beilby, Esq. (Chemical Manufacturer, Glasgow; President of the Society of Chemical Industry).
Dr. T. E. Thorpe, C.B., F.R.S. (Principal of the Government Laboratories; Foreign Secretary of the Royal Society; formerly Professor of Chemistry, Royal College of Science; President of the Society of Chemical Industry).
Professor W. E. Ayrton, F.R.S. (Professor of Electrical Engineering, City and Guilds of London Central Technical College).
Professor H. E. Armstrong, F.R.S. (Professor of Chemistry at the City and Guilds of London Central Technical College).
J. Levinstein, Esq. (Manufacturer of Coal-tar Products, Manchester; President of the Society of Chemical Industry).
Alex. Siemens, Esq.
Hugh Bell, Esq. (Ironmaster, Middlesbrough).
Principal Sir Arthur Rücker, F.R.S. (Principal of London University).
Herbert Jackson, Esq. (Assistant Professor of Chemistry, King's College, London).
A. G. Green, Esq. (Consulting Chemist, London).
Dr. Gordon Parker (Principal of the Herold's Institute, Bermondsey).
Written reports also received from—
Professor M. J. M. Hill, F.R.S. (Professor of Pure Mathematics, University College, London).
Professor Cormack (Professor of Mechanical Engineering, University College, London).
Profesfor Fleming, F.R.S. (Professor of Electrical Engineering, University College, London).
Professor Lunge (Professor of Chemistry, the Polytechnic, Zürich).

It will be seen that there are many in this list about whose qualification to speak with the voice of authority there cannot be the shadow of a doubt.

In the Report, dated 15th July, 1902, of this special sub-committee of the London County Council's Technical Education Board Committee, the matter of the application of Science to Industry is referred to in the following terms:—

"We are convinced that scientific industries have suffered in England, not only through defects in higher scientific education, but, to an even greater extent, through defects in general and secondary education.

"In the majority of secondary schools the curriculum has been so hampered by the exigencies of examining authorities and of examinations, that the teacher has been compelled to devote undue attention to storing the minds of the students with facts for reproduction at the expense of the time which should be devoted to stimulating their reflective powers and making them think. The outcome of the system is that the boys who learn science do not acquire the power of original, or even of accurate logical thought, and that those who do not learn science have no belief in its practical value. In after life those who enter upon industrial pursuits too often regard science with distrust, and to some extent this distrust is merited, owing to the insufficient preparation and training of those who offer themselves for responsible posts in scientific industries.

"We believe that the influence of the Board on the character and efficiency of the science training in the London secondary schools has been in the right direction, and that already much has been done to remedy the defects complained of by those whose acquaintance with these schools is not of recent date. This improvement has been specially marked since the publication of the Report of the Board's Special Sub-Committee on the Teaching of Chemistry in 1896. We are of opinion that, in the majority of London schools, further improvement in the character of the science teaching is needed, and that for this purpose the co-ordination of inspection and examination is essential. We think that the Board should continue to press for increased efficiency in this department.

"The science teaching in secondary schools is valuable almost entirely for its mental training. For scientific instruction we must rely mainly on the subsequent years of University education. . . . There is a consensus of opinion that the highest grade of technical education must be carried on in an institution of University rank open during the day. The few hours which can be given in the evening, by those who are engaged in business during the day, are insufficient for training in research; and the attempt to devote these hours to research work necessitates excessive mental strain, which we cannot expect or desire to see widely incurred."[1]

Touching the defective education provided in England the report says:—

"It is of the highest importance to industrial well-being that adequate provision should be made for original investigation and discovery."[2]

It quotes with approval Mr. J. W. Swan, F.R.S., who called attention to the state of technical education in England in the following terms:—

"One of the most pressing requirements of the moment, demanded not only in the interest of chemical industry, but in that of our manufacturing industries generally, is *adequate endowment and encouragement of research.* Original scientific research is the fountain-head of new knowledge, the vital stimulus of industrial growth, the originator of new industries and sustainer of old. ***But, nationally, in the organisation of our educational and industrial system, we give to scientific research no hospitality***—we barely pay it the respect of recognition. . . . To remedy the existing defects, if you have power to spend large sums of money on behalf of industries, you cannot do better than spend it lavishly. The most pressing need is to help London with University education. ***Comparing our teaching with that in other countries with which we are in rivalry, we stand nowhere.*** The Universities in America have recently received £13,000,000 sterling for education, and that has all been expended in building and equipping institutions and in endowments, thereby reducing the cost to students. Similar advances have been made in Germany and France; hence the wonderful growth of industry abroad. England is doing comparatively little in the way of education, and her trade is declining; whereas America is doing a great deal, and her industries are flourishing. EDUCATION AND SUCCESS IN INDUSTRY CANNOT BE DISSOCIATED. WE MUST REPAIR THE NEGLIGENCE OF THE PAST, OR WE MUST SUBMIT TO NATIONAL DECAY."[2]

The Report defines the suitable practical qualification of a captain of industry as follows:—

"The education of a leader of a scientific industry should include—

"(1) A good general education on the classical or modern side of a secondary school up to the age of 17 or 18, special attention being given to mathematics and elementary physics, the latter being taught in such a way as to educate the mind and fingers of the student to work accurately.
"(2) Three years' training for the B. Sc. degree, followed by—
"(3) Two years' 'post-graduate' work, in order to obtain the D. Sc.

"It

[1] *Loc. cit.*, p. 6, [2] *Loc. cit.*, p. 7.

"It is not enough that he should become trained and proficient in the particular science which is principally applicable to his business. The chemist, for instance, should have a general knowledge of engineering, and the engineer of chemistry. We have, moreover, been impressed by the evidence that the training of the scientific expert should include some knowledge of the industrial and commercial circumstances of his country, and that for this purpose courses in such subjects should form part of his curriculum. There is already a demand for highly-trained electricians; and it is to be regretted that many students are tempted to enter works before they have finished their course of training, which, even when finished, is far from complete. Well-paid posts for trained chemists are at present rare; but the demand is slowly increasing, and will further increase as soon as fully-trained chemists have had the opportunity to prove their commercial value. Mr. Beilby and Mr. Jackson gave instances of well-trained chemists who, having accepted posts at chemical works at very low salaries, proved themselves to be so valuable that they were promoted to junior partnerships. It is for men of this class, who are determined to work their way upwards, that the higher training is specially needed, and it is to them that we must look for the renewal of vitality in our scientific industries."[1]

"We recommend that the Board should continue its present policy of improving the amount and efficiency of the *science training in the secondary schools*, of enabling the polytechnics to improve and extend their chemical and physical laboratories and their electrical and engineering workshops, *of aiding the University colleges and the University of London in their technical departments*, and of awarding substantial scholarships to deserving candidates of scanty means. We are specially impressed by the need of *higher salaries being provided for science teachers*, alike in the secondary schools and University colleges, in order to secure and retain the best men, and to make them independent of students' fees, by the desirability of *lowering the fees at the University colleges*, and by the importance of extending the scholarship ladder, in respect of exceptional students, to a later age than is at present customary.

. . . .

"It is sometimes stated that all money expended on higher technical education is so much lost to the poorer or wage-earning classes. This is very far from the truth; for, unless the highest technical training is provided, and adequate provision made for research and discovery, the creation of new industries will be checked, existing industries may decay, and the demand for skilled labour may decrease. Moreover, if the scholarship ladder is completed, the clever son of the mechanic will be in as good a position, so far as training is concerned, as the son of the capitalist.

"*If it is asserted that England has fallen so far behind in the application of science to industry, that it is useless to expend large sums of money in an attempt to regain a position which has been irrevocably lost*, we would reply that there is no *finality* in any industry; that all industries, if they are to survive, must become scientific industries; and that if machinery is set in motion by which new knowledge is created, old industries will be developed and new industries will arise. If it is urged that no decisive step should be taken to place the machinery for training post-graduate students in technological research on a satisfactory basis until prolonged inquiries have been carried out in Germany, Switzerland, and the United States, to ascertain the latest developments of technical education in those countries, we would reply that there have already been sufficient inquiries, and that *delay is dangerous*. *The cause of the want of vitality in our scientific industries is not far to seek; it is due to defects in secondary education*, and the lack of adequate provision for training in research. If secondary education can be more widely extended, if general and scientific education, both in secondary schools and schools of University standing, can be made more thorough, and if, further, opportunities can be provided to enable post-graduate and advanced students to obtain adequate training in technological research, there is no reason to fear for the future prosperity of our scientific industries."[2]

That nationally our difficulties arise from and are intimately connected with the whole educational scheme is often expressed in the Report in terms of unmistakable urgency. For example: Dr. Merz, of Newcastle-on-Tyne, who had forty years' experience of English manufacturing industry, says:—

"*The centre of the whole educational difficulty lies, I believe, in the deficient secondary education in this country; and until this is improved no marked advance is likely to be recorded. The science teachers at secondary and public schools are not of sufficiently high standard as compared with the teachers abroad. They have too little time for improving their knowledge by further study as soon as they start teaching, with the result that they very soon become mere disciplinarians instead of scientists.*"[3]

The intimate connection between *higher* education and industry appears in such passages as the following:—

"Notwithstanding that England was first in the field with electrical laboratories for students' systematic work, there are now no electrical laboratories in England which can compare for completeness of equipment with those of Darmstadt and Stuttgart. . . . .

"*The prosperity* of electrical engineering in America, Germany, and Switzerland *can be directly traced to scientifically-trained leaders*. It required scientifically-trained men to develope polyphase current machinery; and no one who examined the electrical machinery at the Paris Exhibition could fail to be struck with the rapidity of the progress which is being made all over the Continent.

"That *industries are affected by education* is, perhaps, best proved by the vitality of scientific industries in those countries in which the system of secondary education is supplemented by scientific education of University rank, for the perfecting of which no expense is spared. This condition obtains in Germany, Switzerland, and the United States; and in these countries scientific industries have rapidly developed, whereas in England they have been either stationary or retrograde. When Liebig commenced his work there was, practically, no scientific industry in Germany; in 1897, the total value of the productions of chemical industries alone amounted to £47,391,132. In that year the State expended £31,609 on the Technical High School in Berlin, and contributed 83 per cent. of the cost of maintenance of the Berlin University.

"Education has in Germany fostered the development of industries, but the development of scientific industries has, in return, encouraged and stimulated scientific culture and research in every branch of knowledge."[4]

3. *National Loss through Technical Inefficiency.*—The terms in which *loss of national wealth* are referred to demand notice. The Committee says:—[3]

"We are unable to resist the conclusion that various branches of industry have, during the past twenty or thirty years, been lost to this country, owing to the competition of foreign countries; that in many others our manufacturers have fallen seriously behind their foreign rivals . . . . . These losses are to be attributed in no small degree to the superior scientific education provided in foreign countries.

"We may refer, as the leading case, to the transfer from England to Germany of numerous departments of manufacturing chemistry."[5]

The losses referred to have an indirect as well as a direct effect. Every great industry reacts upon others, and supports and helps them.

The

[1] *Loc. cit.*, p. 7. [2] *Loc. cit.*, p. 8. [3] *Loc. cit.*, p. 5. [4] *Loc. cit.*, p. 5. [5] *Loc. cit.*, p. 3.

The Committee, after pointing out that England pays annually over **£3,000,000 for imported chemical** dye-stuffs, though she actually originated the production—seeing that from 1858 to 1872 she produced more coal-tar products than any other country in the world,—make the following statistical statement, showing the development of foreign dye industries :—[1]

Position of the six largest Colour Works in Germany in 1900.

	Badische Aniline Works.	Meister, Lucius, and Brüning.	Farbenfabriken, Bayer & Co.	Berlin Aniline Co.	Casella & Co.	Farbwerk, Mühlheim, Leonhardt & Co	Total of six firms.
	£	£	£	£	£	£	
Capital	1,050,000	833,000	882,000	441,000	Private concern.	157,000	About £2,500,000
No. of Chemists	148	120	145	55	60	......	About £500
No. of Engineers, Dyers, and other technologists	75	36	175	31		450	About £350
Commercial Staff	305	211	500	150	170	......	About £1,360
Workpeople	6,485	3,555	4,200	1,800	1,800	......	About £18,260
Dividends in 1897	24 %	26 %	18 %	12½ %	Not known.	9 %	
,, 1898	24 %	26 %	18 %	15 %	,,	3 %	
,, 1899	24 %	26 %	18 %	15 %	,,	5 %	
,, 1900	24 %	20 %	18 %	?	,,	Nil.	

Casella's, for which the details are not given, is one of the greatest, if not the greatest, of the aniline dye-works of Germany.

The Report comments upon the loss of such an industry in the following terms[2] :—

"The loss of this vast and growing industry is of serious import to us. We learn that 'the new colouring matters, made almost exclusively in Germany, have in many cases been introduced as substitutes for natural products, which were staple articles of English commerce. Madder and cochineal have been replaced by alizarin and azo-scarlets, the employment of many dye-woods has greatly decreased, whilst at the present moment logwood and indigo are seriously threatened. The complete capture of the indigo market by the synthetic product, which would mean a loss to our Indian dependencies of £3.000,000 a year, is regarded by the Badische Company as so absolutely certain that, having already invested nearly £1,000,000 in the enterprise, they are at present issuing £750,000 of new debenture capital to provide funds to extend their plant for this purpose.' We have long had explicit warning that such a development was impending."

Industrial effort, to be successful, must be in constant touch with scientific achievement, and depends upon a suitable type of education. That this is so, can be seen readily enough by reviewing the history of industries which, originating in England, have lost their reputation through foreign competition, the articles having, by the aid of science, been produced more *cheaply* and in *better quality*.

As further illustrating this point, the following passage may be quoted :—

"We turn to another typically English industry in the production of fine glass for scientific and optical purposes. *A generation ago the bulk of this manufacture was in English hands.* After long continued experiments in the laboratory, German chemists have succeeded in introducing such modification in the manufacture of optical glass that the opticians have been enabled to place on the market lenses approaching more closely to mathematical perfection than any previously manufactured in this country. It is also worthy of notice that the experiments carried out in connection with optical glass have created in Germany several subsidiary industries. We may mention the following :—The manufacture of thermometers for accurate physical measurements, the manufacture of X-ray tubes, the manufacture of lamp chimneys, which are warranted not to burst ; and of boiling flasks, which are warranted not to crack. It is interesting in connection with this inquiry to notice that in the introduction to the price list of the Jena Glass-works, where the results to which we have referred were accomplished, '*sincere thanks are offered to the Prussian Bureau of Education and to the Diet (Legislature) of the Kingdom for the very liberal and repeated subsidies by which costly experiments on a manufacturing scale had been rendered possible.*'"

. . . . "We may cite, as our third instance, the rapid development in the United States, Germany, and Switzerland of the various branches of the manufacture of electrical machinery, as compared with the relatively slow progress made in this country. In 1890 the imports of electrical appliances and scientific apparatus were too insignificant to be separately scheduled. In 1901 they amounted to £1,174,000 and £522,000 respectively. . . . .

. . . ." Professor Ayrton tells us that "if they want a piece of electrical machinery constructed according to a well drawn-out specification, English buyers give their orders to other countries. For dynamos, manufacturers send to Germany ; for magnet steel, to Germany or France ; for the materials for resistance coils, to Germany ; and for the paper used for insulating underground cables, to America. Engineers regularly import manufactured articles from America, Germany, and France, not merely because of the lower price, but because they are distinctly better than anything that can be obtained in this country irrespective of price. In fact, in many cases the article labelled 'made in Germany' is really sought after by the buyer. The reason for going abroad for such materials as the above is that the *English manufacturer has too little idea of the value and importance of minute attention to scientific details.*"

. . . . "In the whole range of the manufacture of ceramics, foreigners are in advance. The pottery manufacture depends upon chemistry, and while the ordinary pottery manufacturer here is characterised by considerable ignorance of his subject, and does not appreciate the importance of employing chemists, in America there is a very different attitude. The manufacturers themselves are nearly all chemists, and although they have not such good raw materials, they are rapidly overtaking us in developing the manufacture of ceramics."[4]

The limitations in a nation's competition with others, which arise from scientific or educational indifference, do not end with the particular industry immediately affected. Every successful industry stimulates others and in this way reinforces the wealth and power of the nation in many ways. Touching this point the Committee say—

"We would here point out that *the loss of an industry*, or part of an industry, *has far-reaching effects. It prevents the birth of cognate industries*, which every healthy industry tends to produce ; thus, the coal-tar colour industry in Germany has given birth to the manufacture of sulphuric anhydride, of synthetic medicinal agents, perfumes, sweetening materials, nutritives, photographic developers, and antitoxins. *It discourages research*, and by forcing buyers to seek certain goods abroad, induces them to purchase other goods which can be obtained equally well at home. . . . . . ."

"We

[1] *Loc. cit.*, p. 5. [2] *Loc. cit.*, p. 3-4. [3] *Loc. cit.*, pp. 4-5. [5] *Loc. cit.*, p. 4.

"We note also that, following the establishment of an elaborate scientific study of brewing, the exports of beer from Germany and Holland have risen from £736,750 in 1890 to £1,177,600 in 1901. Finally, it is not without significance that a large proportion of the mining engineers, metallurgists and chemists employed in the numerous mining enterprises of our Colonies are drawn *not from the Mother Country, but from Germany or the United States*"[1]

These quotations from the Report testify that the Committee felt most keenly how much, educationally, there is to be done, and how great the loss that has arisen from our relative indifference to higher scientific education, and indifference to that thorough secondary education which must constitute the foundation upon which alone the former can be built up.

4. *Individual Testimonies as to Adverse Effect of Indifferent Technical Education.*—The testimonies as to the cause of British failure in the march of industrial progress to maintain such a place as her national prestige and opportunities demanded, are so important that reference is made to significant passages from several of the witnesses.

Mr. J. W. Swan, F.R.S., says:—

"All industries are affected by the want of higher technical training, and foreign nations have gained a great advantage by *the training of their leaders of industry*, who are superior in this respect to those of this country. The foreign manufacturer has in the past shewn more *foresight* than the English manufacturer, and a higher appreciation of the value of scientifically trained men, *and he pays them better salaries* . . . . . . In electrical industries the business is carried out on an enormously larger scale in Germany than in England; as an instance, one of the German electrical engineering firms had recently on the books orders amounting to £10,000,000."[2]

Referring to the reasons of our loss of industrial vigour, Mr. Swan continues:—

"One reason is the want of thorough education on the part of the middle class. In Germany the number of persons passing through the University is far greater than in England. The effect is to supply more men of wide general knowledge and high mental training, who naturally exert a great deal of influence in industrial circles."

. . . .

"I think that recent loss of trade here has produced some tendency to reform, and that *here and there you will find a manufacturer who is appreciative of the value of scientific advice*, and ready to adopt new methods."

"In respect of the training of leaders of industry, I advocate the fullest and most thorough general education that can be given."

"*A kind of training much required is training in 'methods of research,' and every encouragement should be given to attract post-graduate students*, for I regard them as the right men to place our manufacture on a sound basis."

. . . .

"From the standpoint of the manufacturer, I am of opinion that a supply of well-trained men is an urgent necessity, and that they would greatly help to improve industrial conditions as in Germany."

. . . .

"*At present the standard of teaching here is not sufficiently high, and students are considerably hampered by examinations.*

"Without wishing in any way to disparage the expenditure on the more elementary forms of education, I consider that greater importance should be attached to the improvement of the higher grades of education."

. . . .

"In the provinces the equipment of the higher educational institutes is better than in London, and fees are lower. Scotland is exceedingly well off in regard to educational facilities, and is holding its own in respect to foreign competition better than England.

"*Our English system of scientific and technical education is not equal to the present needs of the country*, seeing how severely we are pressed on every side by the most energetic and intelligent competition. We are giving to the classes at the bottom of the industrial ladder a disjointed smattering of miscellaneous science of no great value, though probably good so far as it goes, while we are neglecting to thoroughly educate those upon whose shoulders will soon rest the weight of the management of our great manufacturing industries."

. . . .

"One of the most pressing requirements of the moment, demanded . . . . . in the interest . . . . . of our manufacturing industries generally, is *adequate endowment and encouragement of research*."[3]

Professor Cormack's remarks as to the consequences of unreadiness are much to the same effect:—

"*All* branches of electrical industry depend for success and development on scientifically-trained leaders.

"As an example of our unreadiness, I would quote the progress of dynamo construction. Dr. John Hopkinson laid down the principles of scientific design. America and Germany had men ready to understand and apply them, with the result that *we are now practically 'copying' their methods and their models*. In electric traction we are also behind, for similar reasons."[4]

That Professor Cormack's view is justified has been confirmed by subsequent history of German achievement (*e.g.*, in the fast running of electric cars, etc.). The scientific nature of the limitation has been previously referred to, and there is no doubt that the inferiority of the English system of secondary education, as compared with that of Germany, is one of the largest factors in the limitation.

Professor Fleming, F.R.S., puts the matter very strongly when he says that:—"*At University College, London, for instance, the present provision is not equal to that in a third-rate German or American technical college*,"[5] yet that college has very eminent teachers. It is this fact of indifferent equipment, and an educational system which does not satisfy the requirements of preliminary qualification for higher scientific studies, which so seriously prejudices our national effort.

Sir Bernhard Samuelson, Bart., F.R.S., offers, on the other hand, some testimony which is more hopeful, when he says:—

"I believe that employers have, within the last ten or fifteen years, become keenly alive to the value of technical training on the part of those occupying the higher posts in industrial works, and that they will be grateful to the London County Council for anything that it may do to encourage and promote such training."[6]

Sir Henry Roscoe, F.R.S., agrees with the view that industrial development depends upon the traditions as to scientific training and its utilisation as an industrial guide. His remark is very significant that—"The successful development of chemical industries in Germany is largely due to the fact that *men of high culture, who have had a scientific training, have been engaged as leaders of these industries. English manufacturers are less appreciative of the importance of a high scientific training than those abroad.*'[6] That

[1] *Loc. cit.*, pp. 4-5. [2] *Loc. cit.*, p. 13. [3] *Loc. cit.*, pp. 14-15. [4] *Loc. cit.*, p. 15. [5] *Loc. cit.*, p. 17. [6] *Loc. cit.*, p. 18.

That this indictment is not without justification appears in the remark of *Professor Frank Clowes* that—

"It is difficult to find employment for well-trained chemists. There is less demand for them than for trained engineers or electricians, and the salaries offered are not attractive—generally, about £70 a year to start with, without sufficient prospect of advance." . . . "The fees at our colleges, combined with the cost of living, do certainly deter some of the right men from coming to college; but, even if the former were halved, I do not think many more students would be induced to study chemistry unless the prospects of employment were more sure and more attractive."[1]

£70 a year for a highly educated chemist, without adequate prospect of advancement! Is it any wonder that good scientific guidance is not available to manufacturers, and that they pay the penalty of neglect.

Professor J. Dewar, F.R.S., speaks in the same strain. He states that—"In the coal-tar industry the British manufacturer has been able to retain his trade as far as the simpler products obtained by the distillation of tar, such as naphtha, are concerned, but he has lacked the initiative to develope the industry beyond the manufacture of these simpler products and the sale of raw materials. *This is due to the manufacturers not having appreciated the value of scientific assistance in the development of the coal-tar industries*, for there is no reason why the raw products should not be worked up here just as well as in Germany. We supply raw material for this industry to Germany; so evidently it is not because Germany is in a better position that the colour industry has been developed there. The industry was created in this country, *but since Hofmann left England there has been no one to prosecute the researches necessary to keep it on a forward footing*. The first makers of coal-tar colours did not encourage good men to enter their works; the salaries offered were insufficient, the laboratory equipments meagre, and the *opportunities for research were not favoured. Suitable men were available, but manufacturers would not employ them.* There is no doubt that this industry could have been maintained here had manufacturers adopted the same principles as in Germany and had written off, say, £10,000 a year for the purpose of research work. *I do not know of any firms in England where chemists are employed in research work;* whereas in some of the German firms as many as one hundred chemists are thus engaged and well paid, competent men receiving salaries of £1,000 and more. Also, in Germany, the manufacturers co-operate for the general good of the whole trade, and in some instances have established joint laboratories for commercial research . . . ."

Too many of our manufacturers are under the impression that their industries have reached a stage of finality incapable of further development or improvement. Until they are made to see that there is no such thing as finality they are not likely to appreciate the advantages that would accrue from research. . . . .

"In respect to the training of scientific men for industry, *an improvement in secondary education is most necessary. The instruction in our great schools should be altered, the fundamental training of which is incompatible with the times. Until this training is altered, so as to make it more mathematical and physical, and until more attention is paid to modern languages, we cannot expect to fight the German successfully in the industrial competition.* Beyond this, I would recommend the establishment of at least one institution where students could be trained to methods of research, and also an increase in the number of research scholarships. Although a demand for men trained at such an institute might not be forthcoming at once, the money spent upon its establishment would never be wasted. It is of no use waiting until the demand comes for highly-trained men; the material must be created first."[2]

Professor Dewar's opinion, viz., that substantial reform in secondary education is essential, is consistent with the trend of reform in secondary education everywhere.

Dr. Merz, himself a chemical manufacturer, says:—

"German chemical works were unsuccessful until these newer industries were started; their success is to be attributed to men who possessed the requisite scientific training, whilst *England has not taken the opportunity of training men so as to be capable of developing such industries.*

. . . *There is a lack of enthusiasm amongst the students as compared with Germany.* Abroad, enthusiasm is a kind of tradition comparable to public school life here, and it is fostered by a sufficient number of first-rate men, who from their student days onward keep more or less in touch with each other." . . . "*Abroad, knowledge is the test for any advancement*, and there is no other inducement before the German student than the importance of securing a professional reputation."

. . . .

"In electricity, although England was formerly ahead in respect to the machinery required for continuous current work, yet in alternating current work and for the three-phase and polyphase systems of working, Germany, Switzerland, and America have now got hold of the trade, Switzerland being in advance of any other country. To-day dynamos are imported from America and from Zurich. I attribute this to some extent to the better educational facilities offered abroad, and to the better appreciation of the value of scientific help on the part of manufacturers.

"The money spent on education here is, in my opinion, too much divided, *and the standard of the work is too low.* The centre of the whole educational difficulty lies, I believe, in the *deficient secondary education in this country*, and until this is improved no marked advance is likely to be recorded. *The science teachers at secondary and public schools are not of sufficiently high standard as compared with the teachers abroad. They have too little time for improving their knowledge by further study as soon as they start teaching*, with the result that they very soon become mere disciplinarians instead of scientists."[3]

Professor Sir William Ramsay, F.R.S., in his evidence said:—

"The coal-tar colour trade left us with Hofmann. Had he stayed in this country, I believe this industry would have remained with him; and he would have stayed had a suitable position been created for him. His leaving, I should say, was essentially due to the better salary offered him in Berlin. The arrangement when he left was that he should try Berlin for three or five years, with the option of returning to South Kensington if he wished; but, as is well known, *he refused to return.*

In respect to this question of salary, I may state that *his successor at Berlin makes from £6,000 to £7,000 a year by his professional and examining work.* The examining work in Germany goes with the professorial chairs. Many of Hofmann's pupils were excellent chemists, and have made their mark as leaders of industry.

Among other industries that have been particularly developed abroad by the application of science, I would mention the glass industry at Jena, which has been created by scientific research; and the manufacture of yeast for brewing purposes, which has been very largely developed in Germany."[4]

Touching

[1] *Loc. cit.*, p. 19. [2] *Loc. cit.*, pp. 19-20. [3] *Loc. cit.*, p. 20. [4] *Loc. cit.*, p. 23.

Touching the question of the relation of secondary education to higher technical education, Professor Ramsay offers a positive opinion that the classical training is the best preparation. He says:—

"In respect to the training of the future leaders of industry, the method that recommends itself in Germany is the encouragement of research. *It is found that those who have had a Gymnasium training in mathematics and classics up to the age of 18, and have subsequently studied for three or four years at one of the universities, come to the highest rank in industrial work.* I am told, both by professors at the universities, and by those at the polytechnics there, that the university men are the most productive and the most economical. *The spirit of research is more active in the universities, whereas in the polytechnics the training is of a more routine character*, and is generally confined to what has been already discovered. Moreover, in their universities, research is conducted without reference to industry, in contradistinction to the research work of the polytechnics which is more concerned with minor improvements in any one industry.

"The result of this is, that the university trained men are more likely to create new industries. In this country the "university" trained men—meaning by that, men trained at Oxford or Cambridge—have not, as a rule, done much in science. This I attribute to the *purely examinational nature of their training* and the want of power in their teachers to form a 'school of thought,' *partly owing to their being hampered by examinational restrictions, and partly also through their having been themselves educated under analogous influences.* Almost the sole career open to men having gone through such a training is *schoolmastering*.

. . . .

"Speaking generally of the training, the students should enter their college curriculum when about 17 years of age, and should have received a good general education. *I prefer those coming from the 'classical' rather than the 'modern' side of our public schools, because they are usually well taught; whilst those who come with a smattering of science which has frequently to be 'undone,' are, in my opinion, more deficient in general education.* The study of science cannot be properly grasped by any boys under 17 years of age."[1]

In this opinion it must be remembered that Sir William Ramsay is referring to the kind of science teaching to be found in English secondary schools. The comment has no application to the science teaching, say, of the French Lycée, or that in the German Oberrealschule or Realgymnasium. The same may be said also of the other branches of teaching in England and Germany. The German system involves original effort and original work.

Again, the remark that the study of science cannot be properly grasped by *any boys under* 17 *years of age is not to be taken* too strictly. Modern methods of teaching ensure that, in the measure of his own mental development, each pupil will justly apprehend the subject-matter of science as of other teaching. His grasp will develope *pari passu* with his intellectual grasp generally; his knowledge of science will enlarge with the extension of his mental horizon generally. The teaching of science in the secondary schools of Europe, so far as the Commissioners are aware, instead of being of the character which has to be *undone*, is a *sound foundation* upon which true university work can be established; while in English Universities, the science teaching has necessarily to commence with elementary matter—in fact, the University work cannot transcend the plane of mere secondary science-teaching unless the cause is quite special.

Sir William Ramsay points out further difficulties in Great Britain. He says, further:—

"Manufacturers are not as yet sufficiently alive to the necessity for employing chemists, or at least thoroughly trained chemists, and prefer, in many cases, men who have been trained in their works. While this secures for them *acquaintance with their particular process of manufacture, it does not ensure that wider knowledge which is most useful in the long run.* But it is necessary in the meantime to face facts; and it is a fact that many thoroughly trained and competent young men are seeking for posts, and so far as the teaching profession is concerned, the supply exceeds the demand. Men trained on the Continent, moreover, are often at a disadvantage in being away, and thus missing the necessary push-forward which they would obtain from their teachers in English colleges; for Continental recommendations are not of much use among English employers."

. . . .

"*The only other point that I would refer to in connection with teaching is the necessity for increasing the salaries of the professors. If we want to attract men of the calibre of Hofmann, good salaries must be paid.* London has lost several good men quite recently owing to the attractions of *higher salaries which have been offered to them in the provinces.*"

. . . .

"In order to bring home to the manufacturers the practical value of their employing highly trained men, they should be enticed to visit our colleges and to see the work that is there being carried on. It is very necessary to bring them more intimately into contact with the colleges, and one way by which this may be effected would be to induce them to send problems to the colleges for solution, the work connected with such investigations being carried on by the advanced students. The investigations should, of course, be private and remunerated, though the remuneration need not be high. Such work would, in addition to bringing home to the manufacturers the value of research work, be also a valuable help to the student in bridging over the gap between his training in pure science and its industrial application."[2]

Mr. T. Tyrer, a chemical manufacturer who gave evidence, goes straight to the point when he refers to the scientific enthusiasm which is inspired by the scientific teachers of Europe. The enthusiasm which spends itself on cricket, football, or rowing in the English student, finds expression in another direction in the student of Germany. Mr. Tyrer says:—

"The influence of Hofmann and his methods of teaching were quite remarkable. *He imbued the students with the greatest enthusiasm for their work.* He spent a great deal of time in personal contact with them in the laboratory, and many of his best students subsequently became his private assistants. To-day I believe there is scarcely a chemist who acted in this capacity who has not made his mark either in pure or in applied science.

. . . .

"The American institutions which I have visited, such as the John Hopkins University, at Baltimore, the Lehigh Valley University, and the Massachusetts Institute of Technology, at Boston, are magnificently equipped. Practically, every want for teaching purposes is liberally met, and these institutes rival the well-known Zurich Polytechnic.[3] The endowments are so good that the students' fees are comparatively small, amounting to about £8 a year in the case of the high University. The salaries of the professors are from 20 to 25 per cent higher than in England. The men trained at these technical schools have, I believe, proved their value in commercial enterprise. There is a demand for them in America, and I have been struck specially by their employment by wholesale manufacturers of pharmaceutical products. The employers in these firms were purely business men, not trained in science, but they knew that they could make most money by having good scientific help, and they paid liberally for it.

"The financial return from this policy in America is considerable, and, as a manufacturer, I distinctly believe that it would be so here from the point of view of pounds shillings and pence."[4]

If modern industrial and commercial development depend largely upon the extraordinary developments in the fields of physics and chemistry, then enthusiasm therein must be a great factor in national success. Probably no one who is the least familiar with the German student has any doubt as to the point referred to by Mr. Tyrer.

Professor

[1] *Loc. cit.*, p. 23. [2] *Loc. cit.*, pp. 23–24. [3] Since this was written great improvements have been made at the Zürich Polytechnicum. [4] *Loc. cit.*, p. 24.

Professor Meldola, F.R.S., at any rate confirms this when he says :—

"*The statement that German students are more enthusiastic than English students is, I think, true.* This enthusiasm arises from the atmosphere in which they are taught, and I think it would be cultivated by such a special institute as I have sketched.[1]

Dr. T. E. Thorpe, C.B., F.R.S., goes as far as to say that he would, after sending a student commencing at 18 for five or six years to the best available school of chemistry, and letting him graduate, still send him to Germany for two or three years !

Professor W. E. Ayrton, F.R.S., draws attention to the fact that unscientific traditions lead the English manufacturer to think that "*near enough*" will answer any purpose, and he trusts the buyer to find out any defect that there may be in his goods, but does not test them himself before they leave the factory, In Germany and America . . . there exists, as a link between the workshop and the office, a staff of highly trained testers, whose business it is to make absolutely certain that no defective work is sent out. Much more care is given to the general work abroad, and there is a desire to have far more technical skill pervading the whole works than exists here.[2]

Professor Ayrton agrees with the dictum that technical education should be preceded by a good general education, and that those engaged in teaching should be in close touch with actual manufacturing enterprises in which science is applied. He comments significantly also on the necessity of supplementing even general technical education by a high degree of specialism, remarking that at the "Massachusetts' Institute of Technology" at Boston, "there are professors, not only of engineering in general, but of every possible branch of the subject."[3]

In *Professor H. E. Armstrong's* view, much of the trouble lies with the want of scientific apperception on the part of practical business men and leaders of industry. He says ;—

"The training for future leaders of industry is defective from the start. Their school training should be of a more rational character than it is at present. My experience is that the students who come to college are perfectly unfit for their work, and *the first two years of their curriculum are practically wasted in getting them sufficiently educated for their third year. The scientific training boys receive at school is, with few exceptions, not worth consideration—in fact, I would rather they had not had it ; and far too much stress is put on students to pass examinations.*"[4]

Professor Armstrong is satisfied that we can teach as well technically as in Germany, provided of course that the equipments of technical schools were equally good, and that students entered them *properly prepared.*

Mr. J. Levinstein lays stress upon the necessity of working "*definitely for quality rather than for quantity*"—an impossibility, of course, in countries that provide indifferent secondary education, and can gauge merit only by examinations. Mr. Levinstein says :—

"I have had men both from Germany and from Owen's College, Manchester. Comparing their relative capacities, I should say that those trained at Manchester *have at least as good a knowledge of chemistry as the Germans, but their general education is not nearly as good.*"

Mr. Levinstein supports the view that in England those trained on the classical side are the better.

Mr. Alexander Siemens does not so strongly impute English losses of business to defective education of a technological character. He lays stress on the necessity for commercial education. One of the causes assigned by him is the reluctancy of English workmen to adopt new methods, and their view that "there is a certain amount (only) of work to be done," and "the less work (therefore that) each individual does the more the men will be employed"—an opinion the practical effect of which is that "by thus *raising the cost they limit the market and defeat their ostensible object.*"[6]

Mr. Siemens recognises, however, that the educational system is seriously defective.

Mr. H. Bell attributed the difficulties in the iron industry to *economic* and not educational difficulties. He admits that at his own works the men employed "have had no special technical education." With a remarkable *naïveté* he says :—

"The Germans have made use of results arrived at by Englishmen's brains, and the answer to the question, 'Why does England keep behind ?' is simply because it does not *pay* her to do otherwise."[7]

The experience and belief of great Continental works—Krupp's for example—is a sufficient answer to the opinion expressed by Mr. Bell, an opinion which reveals the prejudice which prevents great English manufacturers from recognising how disastrous are the results of our national backwardness in education, and prevents them from being aware of the nature of the contributions of foreign nations to human knowledge.

Professor Sir Arthur Rücker boldly goes to the point when he says that, "in the equipment of our chemical institutes, we are far behind those abroad—in fact, *we are not even up to the standard of the institutes in any second grade town in Germany.*" He believes in the educational collaboration of works and colleges, at least, to the extent of the former making opportunity for the college professors visiting them. He points out also the value of the American system of granting "*long holidays to their professors*" (on full pay) to enable them to visit works and educational establishments, etc.

Mr. Herbert Jackson says that, "*compared with Germany, our teachers are lacking in 'all-round' knowledge.*" Mr. Jackson illustrates the practical advantage of scientific knowledge by a case which is typical of many others. A German patent material supplied for £18 per ton was analysed. It was found that the constituents could be purchased for one third the price (£6 per ton). The German product was at once replaced with advantage to the English consumer.

Mr. A. G. Green, a London consulting chemist, urges the importance of securing the most eminent men attainable and paying them salaries commensurate with their attainments. He gives the following statistics touching the dye and colour industry :—

Colouring matters used by the British Cotton and Wool Dyers' Association.

Aniline colours	English, 22 per cent. ;	Foreign, 78 per cent.
Alizarin colours	,, 1·65 ,,	,, 98·35 ,,

Another important English association used—French, 4 per cent. ; Swiss, 6 per cent. ; English, 10 per cent. ; German, 80 per cent. Six German firms acquired 948 patents in England for colouring matters ; six English firms 86—almost exactly one-eleventh.

Much

[1] *Loc. cit.*, p. 25. [2] *Loc. cit.*, pp. 30-31. [3] *Loc. cit.*, p. 31. [4] *Loc. cit.*, p. 32. [5] *Loc. cit.*, p. 33. [6] *Loc. cit.*, p. 34. [7] *Loc. cit.*, p. 35.

Much more could be quoted to the same effect. Enough, however, has been said in regard to these opinions to shew how urgent is the matter of improved education. Of the authorities quoted, the Commissioner here writing saw Professor Sir William Ramsay, Principal Sir Arthur Rücker, Professor H. E. Armstrong, Professor W. E. Ayrton, Professor Meldola, Mr. Herbert Jackson. One and all, they urge the necessity of marked improvements in our educational method; and not only these gentlemen but also many others who also have an intimate knowledge of the relative state of education in Europe and in England.

5. *Significance to this State.*—What has been said of chemical and electrical industries is practically true generally. The point to be noticed is, that technical education in England has not attained to what it should for, mainly, three reasons:—

(i) Absence of popular appreciation of the significance of science in the creation of national wealth, and of the imperative necessity of its aid in commercial and industrial rivalries with which nationally we must contend.

(ii) The unsatisfactory character of secondary education in Great Britain, resulting in failure to adequately profit by the later and higher stages of education.

(iii) The educational insufficiency of British scientific and technological equipments as compared with those of the countries with whom Britain is in competition.

The first (i) is but the reflex of the state of general education, and the direct consequence of it. A popular appreciation of education brings about a general attitude which enables those who are educated to give the community the advantage of their specialism.

The want of proper organisation of secondary education, and the pronounced antagonism to science, of classical scholars who are wholly ignorant of it, is tending to disastrously reduce England's power to successfully cope with her commercial and industrial rivals.

The attitude to science in the British public school is not one that promotes the establishment of those great scientific and technological establishments, without which Great Britain cannot hope ever to keep pace with her great rivals in industrial effort.

The bearing of it all to the state of affairs here is obvious when we remember that technical education here is in a more parlous state than in England. Nothing short of educational effort equal to that characteristic of Europe will be sufficient. We are already in the background, and *relatively* have been yearly drifting further to the rear. This backward drift tends to accentuate the scientific and technical weakness in which it originated, and can only be made good by a vastly improved system of secondary, followed by a technical system, properly founded, equipped and developed.

6. *Science and Industrial Effort.*—The significance of science to our industrial effort, and the effect that it could have upon the rapid development of our national wealth may be seen best from general considerations.

In *Europe* the training of a forester is highly scientific and thorough, and a German or French forester really knows his business scientifically. His training enables him to deal with forestry in any part of the world. It is based upon an excellent secondary education up to 18 or 19 years of age, and a highly developed professional education following thereupon, in which his instructors are men of high scientific ability.

The forests of this country are sacrificed in a way that is not possible in Europe. No adequate provision is made for the future; and the assistance which science is able to render is not sufficiently availed of. Yet this must make a great difference to the future of our State, and neglect will greatly hamper our development.

Again, the temper of our people is such that the idea of carefully locally investigating and exploiting all natural products has hardly arisen into being. Germany even utilises its "pine-needles" We hew down our forests merely destructively, and never ask whether it be possible to economically profit by the labour of destruction.

We have probably much valuable resin of the sandarac type; we have kinos and tannins, which may be, and it seems probably are, of considerable value,[1] and properly exploited may create a great industry for the supply of tanning agents. It has been shown that the eucalyptus yields an excellent dye-substance—myrticolorin. Means of readily obtaining practically pure eucalyptol have been discovered here.[2]

With a community of the scientific and enterprising temper of Germany or America, these possible sources of wealth can be more readily investigated and exploited, and this is one of the consequences of the spirit evoked by the better education of those countries.[3]

Again, we have a country subject to drought as its normal condition. Its configuration is such that we can never hope that the interior will be materially different in respect of rainfall. It requires special study as regards the method of staying over the droughts. The problem of preserving stock alive is one of difficulty. One of the most important factors of the problem is the exploitation of artesian waters. Up to the present time no competent hydraulician has been charged with an exhaustive investigation of the question of the extent to which the artesian sources may be tapped, and what limitations ought to be insisted on.[4] *This is not because attention has not been called thereto.*

The

---

[1] That has been pointed out by Messrs. J. H. Maiden and H. G. Smith.

[2] By Mr. H. G. Smith, Assistant Curator of the Technical College, of Sydney.

[3] Some effort has been made to exploit some of these sources of wealth, but economic conditions are not very favourable.

[4] The matter of irrigation and artesian water was discussed last year in the Royal Society of New South Wales. (See vol. XXXVIII, pp. lxxvii–ccvii.) Mr. Pittman, Assoc. R.S.M., now Under-Secretary for Mines, and Professor T. W. Edgeworth David, B.A., F.R.S., have discussed the geologic question very fully (*vide* pp. ciii–cliii), and Acting-Professor F. B. Guthrie, the question of the chemistry of the soils (*vide* pp. li–lxv); other gentlemen various other aspects of the whole problem.

The significance of what we are doing is thus referred to in an article on the hydraulic aspect of the problem :—

" *The future of artesian exploitation.*—How to exploit our artesian waters, so as to secure the *maximum economic advantage*—that is the practical question which is presenting itself for settlement; and the future of our artesian system largely depends thereupon. It may be that the area of intake, and the rainfall thereon, is adequate for any number of bores likely to be made. On the other hand, we may be recklessly playing with an economic capital which it has taken centuries to accumulate. Though it is not possible for us to agree with Professor Gregory's conception of the hydraulic aspects of the problem, this, at least, may be fairly inferred from what he says, viz., that the supply may be exhausted, and that the great pressure occasionally manifested is, after all, no sufficient ground for believing the artesian supply to be practically inexhaustible.

" Without in any way being alarmist, it must be admitted that we know altogether too little about the physical and hydraulic conditions of a problem upon which economic development in our arid interior is greatly dependent. We are smilingly drawing on our capital : is Nature not only honoring the draft but keeping our credit balance in her bank everlastingly good? That is what we *want* to know and do *not* know." [1]

This affords an illustration of one of the immediate consequences of better scientific and technical education, viz., that the popular appreciation by thoughtful men of what might be involved in our acts of exploitation would be more vivid, and those with whom lie the power of initiative, viz., the Ministers of State Departments, would have popular support in undertaking investigation through properly qualified persons.

Denmark and her butter production afford another illustration of the value of scientific control. The chemist and bacteriologist have shewn the Danish farmer how to secure a practically invariable product ; and his market is correspondingly assured, his command of price all he could wish.

It is just this popular recognition of the value of scientific assistance—a recognition which comes through school-training—that makes all the difference. And the scientific assistance is likely to be good where the teaching in the elementary and secondary schools is done by thoroughly expert, well-educated, and trained teachers.

7. *Conclusion.*—The urgency of a better system of technical education can only be seen by a comparative study of technical education in Europe, in America, in England, and here. In Europe, especially, it is founded on good elementary and secondary education. This has not yet been developed here.

The comparative study, referred to, reveals that industrial and commercial power is developing in countries which have good educational systems ; and *creative genius* and the *genius of research* are essential qualifications for progress.

Further, it is necessary, not only that individuals should be well educated and trained, but also that the popular instinct should be to turn to those possessing scientific qualification for advice.

In common with Great Britain, the appreciation of the possession of scientific and technical knowledge is quite different from what it is in Europe ; and this is the secret of much of our failure to profit by great natural advantages.

Another cause of considerable loss of industrial and commercial power is the difficulty, in a community, not highly instinct with the advantages of systematic scientific education, of rightly appraising the claims of aspirants to administrative positions. Mere social claims, without technical qualification, and loud-voiced pretension, no doubt play a part in every quarter of the globe ; but they are, on the whole, discounted just in proportion as the real knowledge of the people is raised. Here, again, we see the favourable reaction of good public education.

The only method of bringing our education into line with that of Europe is to make our elementary and secondary education equally good, and to place technical education in charge of persons whose appreciation of technology and science is real and direct. The placing of scientific and technological teaching and effort under the control of persons who have no scientific knowledge, who have contributed nothing to either technology or science, can only be calamitous. This is a question which, however, demands separate discussion.

---

[1] The Hydraulic Aspect of the Artesian Problem. G. H. Knibbs, Journ. Roy. Soc. N.S. Wales, Vol. XXXVII, 1903, pp. xxiv–xlvii. (See last page.)

CHAPTER V.

CHAPTER V.

Industrial Education in Europe and America.

[J. W. TURNER.]

Introduction.—The progressive character of education in Europe and America is well exemplified in the various kinds of industrial schools which have been established in all the large cities, in the interests of those pupils who, having completed the elementary course, are desirous of continuing their education in a well-defined direction, with a view to becoming artisans. These institutions are known by various names in the different countries, but the general English term of trades schools will convey a fairly correct idea of the scope of their work. The classes are conducted in most of the schools both in the day and evening. The day classes are largely composed of (*a*) youths devoting all their time in the school to learning their trade, and (*b*) of youths serving as apprentices, who spend part of each day in supplementing the practical knowledge gained in their employers' workshops. The evening classes are attended by adult tradesmen who wish to become more skilful in their particular calling, and by youths who are engaged at their regular work during the day. The courses are very practical, but not to the exclusion of necessary theoretical training. In Switzerland this class of schools exists for watchmaking, for the finer machine construction, for the building trades, for furniture making, including wood-carving; in Italy, for drawing, painting, and artistic work in wood and iron; in Germany, for drawing and machine construction; in Belgium, for agriculture, training of girls in dairy and poultry management, weaving; in Holland, for building and iron trades; in Denmark, for dairying and navigation; in Sweden and Norway, for drawing, modelling and carving in wood; in Russia, for the building trades and machine construction; in France, for drawing, modelling, machine construction; in America, for drawing, design, mechanical engineering, and building.

The manual training and trade schools of Germany, Holland, and America are treated fully in separate chapters.

Some Phases of the Work in Switzerland.

Reference has been made in Chapter XVIII in the Interim Report to the splendid spirit of the Swiss teacher and his devotion to his noble calling, as evidenced by his attendance during the summer vacation at the Ecole Normale Lausanne, Canton de Vaud, for the purpose of becoming proficient in one or more of the different branches of manual training. These enthusiastic Swiss teachers, in almost every case from small country schools, were engaged in a preparation in some branch of manual work, so as to improve the elementary work of their school; but further, to direct the efforts of those of their pupils who, having completed the ordinary school course, had no other or better immediate opportunities for educational advancement. With this end, we find these teachers taking practical courses, as regularly as the long vacation comes round, in bookbinding, working in wood, wood-carving, modelling, etc. When conversing with these teachers, they emphasised the importance of this work as an educational training, at the same time that they pointed out its value in contributing towards a preparation for some trade, a matter which concerns the majority of Swiss parents.

Our own New South Wales teachers are imbued with the same spirit of devotion to duty. Large numbers of our country teachers gave up their Michaelmas holidays to undertake a careful investigation of the methods of teaching carried on in the larger public schools of the city. When the Professors of Science at the Sydney University arranged to give a course of Elementary Science Instruction during the Christmas vacation, hundreds of teachers responded to the Departmental circular, signifying their eagerness to attend. The true spirit of progress is in our teachers as shown by them entering into their work with so much zest. They deserve every encouragement, and every opportunity to advance in their profession. The Commissioner again urges the desirability of instituting classes at the long vacation for instruction in elementary chemistry, elementary physics, elementary agriculture, botany, zoology, simplest forms of wood-work, and any other subject which would enable the teacher to make his daily work a real living experience.

Institut Agricole, Lausanne.

The students of this College are chiefly sons of men on the soil, who work on their farms, etc., during the busy season, and attend the Institution in the winter months. The Institution is described in the chapter on Agricultural Instruction in some European countries.

Cheese Manufacture, Moudon.

The manufacture of cheese (Gruyere) is carried on at Moudon, a village situated at a short distance from Lausanne. New buildings to form a residential school have just been completed. Youths over the age of 16 are admitted, and the course—a thoroughly practical one—covers a year. The curriculum includes the general treatment of milk and cheese, simple analyses, and information on grasses best suited for feeding cattle. There was nothing elaborate about the institution, but in watching the various processes in which the students were engaged the Commissioner saw enough to convince him that a similar school in our dairying districts would be a decided move forward in the development of what is fast becoming a most important industry. Such a school in our South Coast District, or in our magnificent North Coast territory, should prove very popular.

Geneva.

Geneva.

College of La Prairie.

This is a thoroughly-equipped college on the science and professional side. It is situated in a high part of the city, and the class-rooms surround an open square nicely laid out with trees. The following class rooms came under notice:—

(a) *Manual training in Wood-work.*

Boys attending, 40 in number, are about 14 to 16 years of age. The equipment is good—single benches for boys, an ample supply of lathes and working tools. Sloyd forms part of the course. The workshop is of good dimensions, and is well ventilated and lighted. Pupils work from drawing plans. The teacher of the class is of opinion that wood-work, including carving, has greater educational value than ironwork.

(b) *Art Classes.*

Design and colouring from nature are features of this college. Originality of design is much encouraged.

(c) *Modelling in Clay and Cardboard.*

Several excellent models of churches and other buildings made by the pupils were on view. Some of the models served to indicate the combined work of lads engaged in the building trades. For example, the same model was the result of the work of the bricklayer and the mason, the joiner, the slater, the plumber. The teacher of this section is an advocate for co-operation in this class of work. The students are occasionally sent out to sketch a building, and later on, to make a model of it in their laboratory, from the drawing.

(d) *Wood-carving.*

This class is attended by youths from 15 to 19 years of age, who are taking up the work as a profession. The specimens retained for exhibition purposes shew great excellence.

(e) *Advanced training in Wood-work.*

In this class the student makes his own designs on large sheets of paper and then executes them in wood. The work is in reality advanced scientific construction, closely connected with architectural ornamentation. The workshops are of admirable construction. The class is attended by youths 17 to 19 years of age.

(f) *Metal-work.*

The work is largely with tin. Boys here get all the training that is necessary for the trade of a tinsmith.

(g) *Masonry.*

Drawing and modelling from designs form the practical work chiefly of this class. Apprentices to this trade in Geneva, and the remark applies generally to other building trades in this city, get a greater part of their theoretical instruction in La Prairie. Their practical training is largely obtained in the workshops of their employers.

La Prairie, Geneva, may rightly be designated a trades college. The new wing nearing completion has all the most modern furniture and apparatus, and a well arranged lecture room for lessons in constructive materials. The work is so co-ordinated that when a boy goes through his course, theoretically and practically, he is well qualified for the trade or profession he has taken up, and there have been no gaps between the stages, no overlapping, no waste of energy or time.

Museum of Arts and Decorations, Geneva.

In this institution there is a splendid collection of mechanical and engineering workshops. In the museum may be seen some of the boring instruments used in perforating the Cenis and Gothard Mountains. In the watchmaking shops, theoretical and practical, and in the schools of mechanics and horology, there are 100 students attending a five-years' course. These branches take the place of apprenticeships and turn out skilled tradesmen, who get ready employment on the completion of their course and command full wages. In the show-room of the college there are some splendid exhibits of scholars' work, such as designs, drawings, models, parts of machines, all executed by the pupils. Girls are employed to do the finer parts of the mechanism of watches. The students in attendance range from 15 to 20 years of age. The fee per month for Swiss residents is 5 francs, for foreigners 25 francs.

Winterthur, Switzerland.

This is a small but busy industrial town, not far from Zurich. The great industry is the iron trade, chiefly the manufacture of machinery. It possesses a fine technical college, an ordinary commercial school, and a trades school. The trades school contains a large machine shop, where 110 boys are employed in learning the business of mechanical engineers.

Some Features of Industrial Work in Belgium.

Those responsible for the administration of education in Belgium show a great disposition to specialise in their school work after the primary course is completed. There is always some fitness about their specialisation, and so, where people live by the soil, there, on the most suitable sites, are found such excellent agricultural institutions as Gembloux, Vilvorde, and Héverlé; in Ghent, with an industrial population, there exists a great laboratory, fitted up with a large number of looms of the most modern invention, and other weaving appliances, in a technical college, which is attended by 3,000 students in day, evening, and Sunday classes. In Antwerp, a city with great commerce, and, judging from its shops and other business places, not devoid of artistic taste, there are a commercial high school with splendid equipment on the science side, and a museum of commercial products perhaps unequalled on the Continent, and a professional school for girls—300 in number, ranging from 12 years of age upwards—who

who wish to learn the trades of millinery, dressmaking, design for scientific cutting out of dresses and clothing, the making of artificial flowers, painting on porcelain, etc., and in Ostend and other seaport towns, schools have been established for training youths to become sailors and fishermen. The work of the fine agricultural schools of Belgium is treated elsewhere, but a short description of the unique school at Héverlé will not be out of place here. This institution was visited in company with the Director-General of Agriculture, Mr. Prost, and the Secretary to the Agricultural Department, Mr. P. Vuyst. It is situated a few miles from the capital, Brussels, and is the property of the Roman Catholic Order of the Sacred Heart. The buildings are new, and all furniture and appliances are quite modern. The grounds are 40 acres in extent and consist of splendid pasture and arable land. The school—generally known as the Great Institute—accommodates some hundreds of girls, the great majority of whom are boarders. The director of the Institute is a priest of the Order of the Sacred Heart, and for the special training that the girls receive in agriculture the Government of Belgium grants the Institute a yearly subsidy, and some further assistance in the erection of laboratories, separate from the main buildings, for teaching chemistry. The ordinary subjects are taught by the ladies of the Order of the Sacred Heart, and the science subjects are given by professors from the neighbouring University of Louvain. A fair percentage of the girls who attend the Institute elect to take the course in agriculture. The branches under this heading usually taken embrace horticulture, dairying, the rearing of poultry, and the lighter work of farm life, and, in short, the work in this agricultural college for females aims at improving the condition of the peasant women of Belgium, and making an intelligent peasant class, giving the future wife and mother the opportunity of rearing intelligent children, and advising her husband, if needs be, on matters of common interest on the farm. Héverlé, it remains to say, is attended now generally by girls of the poorer class. The girls have their own vegetable and flower gardens; very little man labour is required ; milk, butter, and vegetables, are all obtained from the estate; a fine buttery is on the premises; a well-equipped dairy has been added; and the Institute is largely self-supporting. So satisfied are the educational and agricultural authorities with the success of the work done at Héverlé in the interests of the children already in attendance, that they have decided to erect additional buildings, and establish a higher college for daughters of well-to-do people, in which they may learn such subjects as land administration, horticulture, laying out gardens, grafting, and kindred subjects.

Industrial Education in Holland.—The Hague.

A brief account.

The Industrial School for Girls, The Hague, (the term industrial is used in quite a different sense from its meaning in England), is under the auspices of a private society for the promotion of education among the working classes. The school has been established twenty-six years. It is attended by 170 pupils —between the ages of 13 and 18 years. The aim of the school is to train working girls to be useful in the home, or as servants, or shop girls, and to give them practical instruction in such branches as will fit them for the duties of housewives. With this end in view, classes, not more than 20 pupils in each, are formed for the following subjects:—Millinery, dressmaking (nine sewing machines at work), embroidery (a very distinctive feature giving quite a character to this very practical useful institution), ironing, ordinary book-keeping, knitting, darning, renovating and repairing old and valuable carpets. In the earlier years of school attendance much attention is given to the usual school subjects. The school is supported in the following manner:—

10 per cent. of annual cost is contributed by the Province.
20 „ „ „ City.
50 „ „ „ State.

The balance is made up of pupils' fees and benefactions. The city has the right, in return for its contribution, to enter four bursars in the school yearly. Much prominence is given to drawing. The classrooms are cheerful and well-lighted, the girls are happy, respectful, attentive and neat. At the entrance to the dressmaking classroom, the following inscription in Dutch may be seen, "Vanity is the rock on which many a one slips." In another place "Happiness of the present is sometimes overlooked by our wishes for the future." And again, "Have the courage to be true, and you will be great and good." "Gentleness and tolerance are two sublime virtues." Most of the ordinary household occupations are taught.

Huishoud School, The Hague.

This is a housekeeping school, and it is attended in the daytime by young ladies. There are 300 in attendance. The institution is under private management entirely. The work is fashionable, and the chief aim of the students is to become good household managers. In the evening the same classrooms are attended by servants and poorer girls for professional reasons. The subjects taken are:—

Foods and their properties.	Values of commodities.
Practical housekeeping.	Needlework.
Preparing and cooking foods.	Ironing.
Making preserves.	Sicknursing.

This institution has its motto also—"Do what you ought to do and the end will be alright."

Ambachtsschool—Zuidoost Binnensingel.

This is a crafts and professional school in The Hague for boys between the ages of 13 and 16 years—a three-years' course. It is attended by 300 pupils, who are taught by 24 professors and teachers. The more important branches of work which came under notice are:—

(a) *House Painting and Decoration*—

Boys at the time of the visit were getting practical instruction in painting the premises, and a motto in a conspicuous part of the classroom was constantly reminding them that "Time flies quickly; use it well."

(b) *Furniture Making*—

Work done from a drawing; theoretical instruction followed by practical examples; wood-carving a strong feature.

(c)

(c) *Clay Modelling*—
This was taken in conjunction with wood-carving and metal-work.

(d) *Carpentering*—
Fine and rough work; roofs and staircases; builders' work generally; older boys engaged here.

(e) *Blacksmiths' Work and Machine Workshops*—
Accommodation for six double-forges. Wrought work—railings, iron gates; all iron-work for buildings done in the shop; screw-cutting. The students at the end of their term get ready employment as improvers on small wages, about 2d. an hour.

In the evening the classes are attended by 100 students, whose desire is to become more proficient in their particular trade. The lessons occupy three hours, one of which is spent in theoretical training, such as drawing, and two hours in practical applications. In addition to craft work, the students are exercised in the Dutch language. The school is maintained as follows:—

Annual contribution from the Province	3,000 guilders.
" " City	16,000 "
" " Government	10,000 "
From fees and sale of articles	2,000 "

This class of school is more fully treated in the Chapter on the Trade Schools of Holland.

Industrial Work as seen in Göteborg: Sloydföreningens Skola, Sweden.

This school is attended by girls from 15 to 18 years of age, and much of the work accomplished is of a very high standard. The girls evidently have much artistic taste. The subjects which receive prominent attention are:—

(1) Drawing—design, freehand, model, mechanical.
(2) Modelling—some very fine work.
(3) Wood-carving—really excellent work.

In this class there was an English girl who, on being questioned as to her reasons for attending these classes, stated that her father had no desire to place her in any trade or business where this particular instruction would give special advantages, but he valued the training for its educational importance.

The Director of the institution is an art connoisseur without doubt, and his tastes are seen in his unique museum, where the girls have placed before them some art subjects of very great beauty. The museum contains choice specimens in glassware, porcelain goods, inlaid furniture, rich carvings, and beautiful models; and its effect upon the work of the pupils was much in evidence, particularly in the carving, which was extremely good. The building is used at night as an evening school for skilled workmen and apprentices. These attend the various classes according to their trades—drawing, carving, modelling—and receive theoretical as well as practical instruction in branches in which they desire to become more proficient. Only a very nominal fee is charged. The attendance in all classes is nearly 1,000 students.

Industry and Art in Kristiania—Industrial Art School.

This is a State institution attended by 200 morning students and 600 evening students. No lessons are given in the afternoons, but pupils are at liberty to attend the classrooms and work on their own account. Much of the instruction is free, and where a charge is made the fee is light. Drawing, designing, modelling, are the chief subjects taught on the theoretical side, and these are practically applied to the building and finishing trades. The students are sent out into the city to take measurements of a building, and when they return are required to draw the building to a plan, show elevations and sections, prepare specifications, and make all the necessary preparations prior to handing the building over to the constructive tradesmen who, in their turn, deal with the structure in their classrooms. The cabinetmaker is engaged in making suitable furniture, the upholsterer is employed on his finest work, and the art decorator is occupied with some beautiful original nature designs in tapestries and panels, showing a harmonious blending of colours, and affording scope for displaying taste. Other of the more delicate arts, such as goldsmith's work in the shape of lovely vases, completes the internal arrangements. The students, male and female, work together in the same classrooms. Students are not compelled to take the full course, they may choose any subject or group of subjects.

The day course is of two years' duration, four to five hours daily. The full art course is of three years' duration, two hours daily. The evening course is of two years' duration, two hours daily.

The Industrial Art School does not profess to be an Art School of the higher grade, but is intended to benefit those students who are artistic in their tastes and who desire to excel in the trades which they have selected.

A Brief Account of Industrial Work in Russia—St. Petersburg Artisan School.

The Tsessarevitch Nicholas Lower Technical School for the training of boys as artisans, is the oldest and largest of six similar institutions in the city of St. Petersburg. The building and equipment cost 500,000 roubles (over £50,000). The institution is supported by the State to the extent of 20,000 roubles yearly, by the city in the sum of 25,000 roubles yearly, and by a Committee for the advancement of education among the working classes in the sum of 200,000 roubles a year. The whole management is subject to the Minister for Finance. Pupils are admitted between the ages of 12 and 15 years on the conclusion of the four years' primary course. In the school there are 340 boys—all in residence—260 of whom pay nothing at all for their support or teaching. The remaining 80 pay 250 roubles a year. The work of the college is divided into two large sections—Mechanical Engineering and Working in Wood. To these late lately have been added classes in Watchmaking and Optical Mechanics. The Engineering section is by far the largest and most important, and the whole machinery in use, the laboratories, the workshops—in fact, the organisation, discipline, and equipment generally for this class of school, are not surpassed by any similar institutions in Germany or Switzerland. The course in this section extends over five years, and specimens of each year's work are kept in the museum. These specimens are the work

work of the students and they shew the excellence and practicality of the teaching. The course in Woodwork lasts over four years, and includes instruction in the ordinary building trades of carpenter and joiner and a special training, near the end of the course, for the finer work of cabinetmaking and carving. Some of the pupils enter the school with a slight knowledge of tools gained in the primary school course, others are admitted without any previous special knowledge of the work. On the completion of their course several boys remain on for the purpose of becoming skilled tradesmen, and they are occupied in the construction of superior furniture, which has a marketable value. While so employed those students taking the supplementary course are paid a rouble a day. Those engaged in working in wood number about sixty. In the Watchmaking section there are fifty boys. The equipment and results while good, do not equal what was seen in Geneva. The attendance in the section of Optical Mechanics is seventy boys. The whole building, with its laboratories and other working-rooms and the dwelling-rooms, are lit with electricity. The dormitories are clean and comfortable; the dining-room is very large and is supplied with thirty-four tables, ten boys at a table, including a captain, who sits at the head; a well-arranged cuisine managed by men cooks; a well-appointed hospital, rooms painted a soft white, under the charge of a medical man who is in daily attendance; a chapel with richly-embellished altars, for Sunday and day services, divided in centre by wooden railing—inside space for boys, outside for relatives.

The visit to this work school for boys between the age of 12 and 20 years gave an insight into some of the characteristics of Russian youth. Speaking only of the experience gained in St. Petersburg, its lads may be truthfully described as intelligent, industrious, sturdy young fellows. Their attention was fixed on their work, they were not afraid to exert themselves at their task—sometimes trying and difficult—they seemed to be on good terms with their teachers, and they were obedient, painstaking, and respectful. The whole institution has many fine features to commend it. There is just one matter in connection with the institution which is causing the management a little serious thought. So well trained are some of the students, and so specially skilled have they become in their work, that they are not satisfied to go out into the world as ordinary artisans but expect better positions and higher wages. The matter will require some adjusting, but the general opinion seems to be that the young skilled workman will not suffer. Conspicuously placed in the large assembly hall is a bust of the late Emperor, paid for by subscription of a large number of pupils of the school anxious to show their appreciation of their kindhearted and munificent royal patron.

United States, America: Manual Training High Schools.

In the large cities of the States a Manual Training High School is as great a necessity as the Academic High School or College. The manual training high schools are attended by pupils who have finished the grammar school course, and the instruction in them is free. The working of these institutions was seen in Philadelphia, Springfield (Massachusetts), and San Francisco. San Francisco, with a population of about 400,000 souls, has no less than eight high schools, three of which are manual training institutions, one supported by the city, the remaining two—the Lick and Wilmerding—are trades schools under separate Boards, being separate benefactions, but having a common principal. The Lick School is attended by both boys and girls, but there is no co-education as the work of each sex has a special bearing—the girls taking up the domestic arts, cooking, dressmaking, &c., the boys building and machine construction. Boys only attend the Wilmerding School, and their work is house construction. The attendance in the Lick School is 500 and in Wilmerding 150. The essential difference between the the two institutions is the period at which specialisation takes place. In the Lick a boy does not specialise until he has completed two years of the four-years' course. During his first year he works in wood, the second year in iron, and then he selects the trade he will follow permanently. In the Wilmerding School the boy, immediately he enters, has made up his mind as to the occupation he will follow for a living. Both classes of students on the completion of their courses, enter on their trades with journeymen's wages. There is no friction with the trades unions, who rather approve of the institutions, while the numbers in attendance have no great effect upon the apprentice question. This much may be said to the advantage of these institutions—their teaching is more general and thorough in its character, and their students get a far better idea of their trades than do apprentices, who, in the iron trade at least, deal only with one particular branch of their business probably during their whole course of training. Wilmerding School is undergoing enlargement. The plans, &c., for the new structure are the work of the students of the Lick School, the actual construction (including excavations, brickwork, carpenters' work, finishing trades), is being done by the students of Wilmerding. The students of both schools are taking a special interest in the work which is the result of their own hands and brains.

(These schools are fully treated in Chapters XVIII, XXI to XXIII.)

CHAPTER VI.

CHAPTER VI.

The Continuation and Trade Schools of Berlin.

[G. H. KNIBBS.]

1. *Introduction.*—The technical education provided in Europe for all classes in the community is usually very thorough, and naturally covers a range which we have not, so far, reached. Among excellent examples of this extensive provision, the "*Fortbildungsschulen*" of the city of Berlin hold a high position. The following account is derived from a publication kindly supplied by the educational authorities of that city.[1] A number of the institutions were visited by the Commissioners, and their excellent buildings and equipments, and the *calibre of the teachers*, shewed that the work being done is of a character in keeping with the attempt to make thoroughly competent workmen—workmen who are also capable of intelligently studying their handicrafts.

The extent to which the courses are availed of may be gathered from the following return for the winter half-year, 1901–2. It gives also an idea of the magnitude of the industrial and technical effort of Berlin in its lower phases. It should be remembered that the returns do *not* include the work done in the higher technical schools.

No. of Courses for		Subject.	Male Pupils.	Female Pupils.
Males.	Females.			
172	81	German..	5,478	2,587
195	68	Arithmetic	5,823	2,303
275	23	Drawing	7,736	475
196	......	Technical Drawing	5,353	......
90	47	Book-keeping	2,419	1,555
25	......	Geometry	643	......
55	......	Physics and Chemistry	1,749	......
78	40	French[2]...	1,702	1,087
76	34	English[2]	1,716	894
96	......	Technical Instruction...	2,439	......
......	73	Manual Training	......	2,292
......	43	Machine-sewing	......	884
......	66	Tailoring	......	1,576
......	25	....	......	597
......	21	Ironing...	......	319
......	30	Millinery	......	736
29	......	Modelling	652	......
......	14	Singing...	......	642
......	13	Gymnastics	......	521
212	157	Various courses	5,912	4,868

The above will give a fair idea of the magnitude of the work done in the "*Fortbildungsschulen.*"

2. *The Continuation Schools of Berlin.*—The Continuation Schools of Berlin may be thus classified:—

I. Municipal Continuation Establishments or Schools.[3]
II. (*a*) Municipal Continuation Schools for youths.[4]
(*b*) The Trades-Union Continuation School.[5]
(*c*) Commercial Continuation Schools of the Corporation of Commerce, Berlin.[6]
(*d*) Trade and Continuation Schools.[7]
III. Continuation Schools for Girls.[8]
IV. Municipal Continuation School for the Deaf and Dumb.[9] 3.

---

[1] Uebersicht über das Fortbildungsschulwesen und die gewerblichen Unterrichtsanstalten der Stadt Berlin. 19ter Jahrg. Febr. 1902. Druck von Gebrüder Grunert.
[2] The French and English is, of course, that thorough teaching which enables pupils to *speak*, not merely to *read*. It is worthy of mention that proficiency is a matter to which increasing attention is given.
[3] Städtische Fortbildungsanstalten.
[4] Städtische Fortbildungsschulen fur Jünglinge.
[5] Die Fortbildungsschule des Handwerker-Vereins.
[6] Kaufmännische Fortbildungsschulen der Korporation der Kaufmannschaft von Berlin.
[7] Fach- und Fortbildungsschulen.
[8] Fortbildungsschulen für Mädchen.
[9] Städtische Fortbildungsschule für Taubstumme.

3. *Municipal Continuation Establishments and Schools.*—The aim of these institutions is to enable persons engaged in practical callings to receive, strengthen, or supplement an education corresponding to that provided in a " middle " school. In the courses in the French and English languages the attempt is specially made to afford a graduated course, in which particular attention is paid to fluent, oral, and written expression; and commercial arithmetic, book-keeping, stenography, and typewriting receive an equal attention.

The *School-fees* are per half-year for a two hours' course per week, 2 marks; and for a four-hours' course per week, 4 marks (4s.).

Applications for admission are made to the Director, and proposals for the deduction of school-fees must be presented to the Director *in writing.*

There are four Continuation Schools in Berlin of this higher type, viz., in the Friedrichs-Gymnasium, in the 1st Realschule (höhere Bürgerschule), in the Dorotheenstädtischen Real-Gymnasium, and in the 2nd Realschule (höhere Bürgerschule).

The utilisation of school buildings for more than one course of instruction is a feature worthy of notice.

In all of these, prominence is given to the teaching of the modern languages, viz., German (the mother-tongue), French, and English. Commercial Arithmetic, Book-keeping, Stenography, and Type-writing are common to all. Mathematics is taught in the first-mentioned institution only, Drawing in the first and last, while Physics is a feature of the last only. Writing is special to the third. Commercial Correspondence and Commercial Science are taught at the third institution.

The instruction is given in the evening between the hours of 7·15 and 10 o'clock, including Saturday, also Sunday morning from 8 to 9·15. This Sunday work is a common feature in Germany.[1]

4. *Municipal Continuation Schools for Youths.*—The object of these schools is:—

(1.) To consolidate and supplement the education obtained merely at a Folk-school (in the case of youths who have entered upon a practical calling), through instruction and practice. The aim also is to stimulate the intellectual and moral strength as well as the professional ability of the pupils.

(2.) To instruct young men even in elementary knowledge, so as to *supplement the deficiencies* of their earlier education.

In all of these schools, of which there are thirteen in Berlin, instruction is given in French, English, Physics, Chemistry, Algebra, Geometry, Book-keeping, Stenography, and Typewriting, but in only a few schools, Commercial Correspondence, Theory of Exchange, Commercial Science, and a knowledge of Merchandise, together with History and Geography, Knowledge of the Law, Professional Drawing, Modelling, Trigonometry, and Caligraphy. In the 9th Fortbildungschule, instruction in the Russian language is also given.

In the majority of the schools much of the instruction is gratuitous, but in the following subjects a half-yearly charge is made:—

	Marks (or Shillings).
A four-hours' course in French, English, or Russian	4
A course in Book-keeping (double entry)...	2
A two-hours' course in Professional Drawing	2
A four-hours' course in Professional Drawing	4
A course in Modelling	1
A course in Compass Drawing	2

Instruction in " Figure Drawing " is given as soon as the authorities have arranged for models at the State cost, and approved of by the State. Pupils taking this course are charged 4 marks (4s.) per half-year. In Stenography and Typewriting, and in Commercial courses, a fee of 1 mark (1s.) per half-year is charged.

Applications are made to the *Director* of the School.

There are no less than thirteen of these schools situated in various parts of Berlin. Instruction is given on every evening in the week, including Saturday, between 7 and 10, also on Sunday mornings between 8 and 12. The time on a Sunday morning is principally devoted to Modelling, and to Drawing in all its various forms (figure, ornamental drawing, and drawing from plaster casts, from the living model, compass drawing, technical, water-colour, ornamental, freehand, drawing of forms, etc.), but in several of the schools some time is also given to caligraphy, arithmetic, stenography and typewriting, book-keeping, and the theory of exchange. Drawing is a prominent subject in all these continuation schools.

The evenings are occupied mainly with the teaching of modern languages (the mother-tongue, French, and English), four hours a week being devoted to each. Science, Mathematics, and Commercial arithmetic are prominent, and Typewriting, Stenography. and Book-keeping (single and double entry) receive attention. In two of the continuation schools a course in Law is given to students, while in another the Theory of Exchange is taught. In one of the schools, four hours a week are devoted to Russian. History and Geography are subjects of instruction in only one continuation school, and in four singing is taught.

5. *The Trades-Union Continuation Schools*—These schools are under the conductorship of an officer appointed by the Committee of Instruction.

The instruction given in this school is arranged as follows:—

(A) *Elementary Instruction*, which is divided into three courses, viz.:—

I, or the Lower Course, including the subjects:—Arithmetic, Caligraphy, Orthography, the Mother-tongue, and Reading. To these subjects four evenings a week are devoted, the hours being 8·15 to 10. The fee charged is 2 marks (2s.) per half-year.

II, or the Middle Course, includes:—Arithmetic, Caligraphy, Writing (round-hand), Orthography, Business Exercises, and Commercial Correspondence, the Mother-tongue, and Reading. Four days a week are also devoted to these subjects, the hours being 8·15 to 10. The fee is 2 marks (2s.) per half-year.

III, or Upper Course, the subjects of which are Simple and Commercial Arithmetic, Computations of Areas and Volumes, Essay and Letter-writing, German and German Literature, local Geography (Vaterlandskunde). The fee is 2 marks (2s.) per half-year.

(B)

[1] And generally speaking throughout Europe.

(B) *Commercial-Industrial Instruction.*—The subjects included under this heading are:—

	Half-yearly.
American book-keeping...	4 marks (4s.)
Book-keeping (double entry)	4 „
„ (single entry) and Theory of Exchange	2 „
Commercial Arithmetic (one of the subjects in the III Course)	....
Elementary French (Koch's Manual of the French language, I Part)	3 marks
Advanced French (Conversation, reading, commercial correspondence)	4 „
Elementary English (Koch's English exercises)	3 „
Advanced English (Conversation, reading, commercial correspondence)	4 „
Stenography, Arend's System (Wednesdays)...	1 „

Ladies may avail themselves of this instruction.

The instruction in this division is given on five evenings in the week, American book-keeping excepted, which is taught only between 9 and 11 a.m. on Sunday. Drawing is also taught on Sunday from 9 to 1.[1]

(C) *Technical Instruction.*—The subjects in this division are as follows:—

(1.) Professional Drawing for Upholsterers and Decorators, and Freehand, Perspective, Compass, and Ornamental Drawing. This teaching is given on Sundays, Wednesdays, and Saturdays, and a fee of 3 marks (3s.) per half-year is charged.

	Marks (shillings).
(2.) Professional Drawing for joiners, turners, etc.	3
(3.) Professional Drawing for engineers, locksmiths, etc....	3
Singing.—For choir-singing (male voices) the fee is	1
For choir-singing (female voices) the fee is	1
Preparatory class	1

	Monthly.
Gymnastics.—Men's Division	0·75 (9d.)
Apprentices Division	0·25 (3d.)
The lessons are given twice a week in the evening from 8·30 to 10 ...	0·50 (6d.)
Women's Division ...	0·50 (6d.)
(One lesson a week from 8·15 to 10 p.m.	

6. *Commercial Continuation Schools of the Corporation of Commerce, Berlin.*—These schools are under the management of a "*Curatorium*," consisting of the following:—

(a) Four representatives of the Corporation of Commerce.
(b) Three representatives of the Mercantile and Industrial Association of Berlin.
(c) Three nominees of the Minister for Commerce and Industry.
(d) One representative of the Junior Merchants' Association of Berlin.
(e) One representative of the Minister for Commerce and Industry, Berlin.
(f) One representative of the City of Berlin.
(g) The Director of the Commercial Continuation Schools.

This makes 14 in all.

The *School-fees* per Semester[2] are:—

For two hours a week	9 marks (9s.)
For four and more hours a week	13 Marks 50 pf. (13s. 6d.)

There are six Continuation Schools of the above description in Berlin, viz., I. Friedrich-Werdersches Gymnasium; II, Luisenstädtisches Realgymnasium; III, Köllnisches Gymnasium; IV, Konigstädtisches Gymnasium; V, 10th Realschule; and VI, 3rd Realschule. These secondary schools are well adapted for use for such a purpose.

The course of instruction in these institutions is divided into two semesters, viz., Summer and Winter, with the exception of No. VI, 3rd Realschule, which has only a Winter semester.

The Friedrich-Werdersches Gymnasium.

First Semester.—Eight hours a week are devoted to the study of the modern languages (French, Russian, and English), both in their elementary and higher stages, and ten hours a week to type-writing, stenography, book-keeping (single and double entry), commercial arithmetic in its elementary and advanced stages, writing, theory of commerce and exchange, commercial methods, and counting-house practice. Two hours a week are given to German and commercial correspondence, and there is also a course in political economy.

Second Semester.—A course in "Knowledge of Merchandise" is given, in addition to the subjects of first semester; the hours of teaching are the same. The language instruction is somewhat more developed, and more time is bestowed upon double entry book-keeping.

The Luisenstädtisches Realgymnasium.

First Semester.—The same amount of time is devoted to language study, Spanish being added, as in the Friedrich-Werdesches Gymnasium. Typewriting and political economy are omitted. The other subjects and hours are similar.

Second Semester.—The language teaching is more developed than in the first semester, conversation being a special feature. There is more double entry, book-keeping, and stenography than in the preceding Gymnasium.

The Köllnisches Gymnasium.

First Semester.—The languages taught are French, English, and Spanish, eight hours a week. Typewriting is omitted, and commercial geography added. The other subjects are similar.

Second Semester.—Italian is added to the languages taught in the first semester. Less time is devoted to double entry, while counting-house practice is included. The

[1] Sunday-schools in Germany are for ordinary teaching. Pupils receive systematic religious instruction in the ordinary school course.
[2] A semester is a term of a half-year.

The Königstädtisches Gymnasium.

First Semester.—The only modern languages taught are English and French, to which eight hours a week are devoted. The theory of commerce and exchange and of commercial interest are omitted from the programme; other subjects are similar to those of the preceding "Gymnasien."

Second Semester.—The programme is substantially identical with that of the first semester, stenography and typewriting being distinguishing features.

The 10th Realschule.

First Semester.—The languages taught are English, French, and German, ten evening hours a week being devoted thereto. Typewriting and commercial correspondence are omitted.

Second Semester.—The programme is identical with that of the first semester.

The 3rd Realschule.

In this school, instruction is given only during the winter. The languages taught are French and English, eight hours per week. Four hours a week are devoted to book-keeping (single and double entry), stenography, German, and commercial correspondence, writing, the theory of commerce and exchange, and commercial arithmetic.

7. *Trade and Continuation Schools.*—These Trade and Continuation Schools are maintained by the State, the city, the Sunday Free-school Union, and the various guilds.

The Administrative Council of each school is somewhat similar. In some instances the Minister of Commerce and Trade, the Royal Police Præsidium (Königl. Polizei-Präsidium), and Industrial Deputation are represented by Commissaries, while others are represented only by a Commissary of this last. There is also a "Curatorium" and a Director.

There are seven Trade and Craft Continuation Schools, one belonging to each of the following trades, viz., the Trade and Continuation Schools:—

(1) Of the Shoemakers.
(2) Of the Saddlers', Harness and Trunk makers' Guild.
(3) Of the Smiths.
(4) Of the Chimney-sweeps' Guilds.
(5) Of the Bakers' apprentices.
(6) Of the Tailors.
(7) Of the Potters' Guild.

The *first school* is divided into six classes, in the two higher of which Drawing and Book-keeping are taught from 7·30 to 9·30 on two evenings a week, the remainder of the classes are devoted to Reading, the mother-tongue (German), Arithmetic, and Drawing, an hour a week in the evening being given to each.

The instruction is free for apprentices, but journeymen or masters pay a fee of 1 mark (1s.) per quarter.

In the *second school* there are five classes. The subjects of instruction are Professional Drawing, Theoretical Instruction, and Book-keeping. There is a Drawing-class from 9 to 1 on Sundays. There are also practising-classes for the manufacture of trunks, harness and saddlery (riding-gear), and tapestry and carriage work, on Sunday mornings between 9 and 1.

The fees per half-year are 2 marks (2s.) for apprentices, and 6 marks (6s.) for journeymen.

In the *third school* there are four classes, in which lessons are given in the mother-tongue (German), Arithmetic, and Compass Drawing. These classes meet on Sunday morning between 8·30 and 12·15.

In the *fourth school* there are three classes, viz., one for journeymen, in which instruction is given on Sunday from 9 to 1 in German (the mother-tongue), Arithmetic, Drawing, and practical work. The other two classes are for apprentices, the subjects taught being Drawing and Professional instruction from 10 to 12 a.m. on Sunday, and German and Arithmetic from 5 to 7 p.m. on Saturdays.

The fee for journeymen is 4 marks (4s.) per semester. No fee is charged for apprentices unless they have been in former employment, when it is likewise 4 marks (4s.) per semester.

In the *fifth school*, maintained by the Bakers' Guild, "Germania" instruction is given in Chemistry[1] and Book-keeping from 3 to 5·30 every Wednesday in (*a*) the Fachschule; and in (*b*) the Fortbildungschule in Arithmetic and German from 3 to 5 on the same day.

In the *sixth school* there are five classes, meeting on a Monday from 4 to 8 p.m. In four of the classes the time is devoted exclusively to the study of Arithmetic, but in the first class an hour a week in addition is given to Book-keeping.

For each participant, the Tailor's Guild must pay 1 mark (1/-) per quarter.

In the *seventh school*, which is maintained by the City and the Potters' Guild, there are four classes, which meet on Monday and Thursday evenings from 6 to 8. The time is devoted chiefly to theoretical professional instruction, professional drawing, drawing from plaster models and wood models. The two remaining subjects, German (the mother-tongue) and Arithmetic are taught only in Class IV.

In this school during the summer semester no instruction is given.

8. *Continuation Schools for Girls.*—The continuation schools for girls may be divided into two classes, viz.:—

(A) Continuation Schools under Municipal control.
(B) Continuation Schools established by Unions or "*Curatoriums.*"

There are nine schools of the former type and four of the latter in Berlin.

The object which is aimed at in the Continuation School is to consolidate or to supplement the education usually received by every girl engaged in practical employment of every kind, so as to give mental stimulus, to confirm an earnest view of life, and to foster both inclination and skill in all work suitable for women. Older women who desire to make up for the loss or absence of opportunity of education in youth, may also avail themselves of the instruction afforded by these schools. On the other hand *the idea that the schools must serve exclusively for technical instruction is not to be entertained. That* is at least the expressed official view.[2] A

[1] Attention is drawn to the fact of some knowledge of this science being deemed necessary for bakers. In fact, the general idea is that the essential nature of each operation should be thoroughly understood.
[2] Attention is drawn to this fact.

A somewhat detailed treatment of these schools appearing to be desirable, the *Continuation School under Municipal control* will be dealt with first.

School Fees.—For pupils taking the entire course, with the exception of Ironing and Dressmaking, the fee is 0·50 marks (6d.) (in advance) monthly. For those who also take *either* Ironing *or* Dressmaking, the total fee is 1 mark (1s.) per month, while those who take both Ironing and Dressmaking pay monthly 1·50 marks (1s. 6d.). For the month of July no charge is made.

For tuition in languages, a half-yearly charge, payable in advance, is made for each course of as many marks as there are instruction hours in the week.

For courses in Stenography and Typewriting the fee is a half-mark a month, and for a cooking course, 4 marks (4s.) per half-year.

In the first of the nine "*Fortbildungsschulen*," the languages taught are German, 6 hours evening, 8 hours afternoon[1] per week; French, 8 hours, and English, 8 hours, afternoon. The other subjects are Arithmetic, 8 hours (6 hours evening, 2 hours afternoon); Drawing, 2 hours evening; Book-keeping, 2 hours evening; Commercial Correspondence, 2 hours evening; Stenography, 6 hours evening; Typewriting, 6 hours evening; Needlework, 14 hours (7 hours evening, 3 hours afternoon, and 4 hours morning); Cutting-out linen articles, 2 hours evening; Sewing-machining, 4 hours (2 hours evening and 2 afternoon); Dressmaking, 18 hours (6 morning and 12 evening); Ironing, 4 hours afternoon; Millinery, 4 hours (2 evening and 2 morning); Singing, 2 hours evening; Gymnastics, 4 hours evening; Caligraphy, 4 hours evening.

In the *second school,* much less time is available for languages (German, French, and English), Arithmetic, and Stenography. More time is given to Book-keeping, and still more to Drawing, Cutting-out, Sewing-machining, and Millinery. Commercial Geography is taught; but Gymnastics, Commercial Correspondence and Caligraphy are absent from the programme.

In the *third school,* the subjects of instruction are much the same as in the second. Gymnastics is included and Commercial Geography omitted.

The programme of the first school is substantially a type of all the others. If variations occur as to the number of the subjects taught and the arrangement of the time, they are but slight, and the general character of the whole remains unchanged. Machine-stitching and cooking are features of the *fifth and eighth* schools, while repairing is confined to the last, No. 9.

Throughout, prominence is given to instruction in useful work suitable for women, while cultural branches of knowledge are not neglected. The dominant idea is, of course, that the instruction should be *practical.*

9. *Girls' Schools under Unions or Curatoriums.*—The other class of school, viz., those controlled by Unions or "*Kuratorien,*" may now be referred to.

As before observed, there are four of these schools, viz.:—

(1) The Victoria-Fortbildungsschule (Continuation School).

(2) The Fortbildungsschule in Auguststrasse.

(3) Commercial and Industrial Continuation School for young women, Alte Jacobstrasse.

(4) Trade School and Commercial Continuation Institution for girls in the Dorotheen Municipal Realgymnasium, Georgenstrasse.

The Victoria Fortbildungsschule.—The fees are as follows:—

For the Evening School:

For the whole instruction the fee is 1 mark (1s.) per month.
The instruction in German is obligatory.
Dressmaking, machining, cutting-out, ironing, 0·50 marks (6d.) each a month.
Cooking, monthly, 6 marks (6s.).
The duration of the course is three months.

For the Day School:—

The fee, according to the number and connection of the courses, is from 3 to 12 marks (3s. to 12s.) monthly.
The instruction in German is obligatory.
The inscription fee is 0·50 marks (6d.).
Reduction and exemption of fees are assured upon special recommendation.

The subjects of instruction in the Evening School are:—

Subjects.			Hours per Week.	Subjects.			Hours per Week.
German	4 courses,	each	2	Arithmetic...	4 courses,	each	2
Book-keeping (single entry)	2 „	„	2	Commercial Correspondence	[2] 2 „	„	2
Industrial Drawing	1 „	of	2	Needlework	3 „	„	4
Repairing	3 „	each	4	Cutting-out Garments ...	1 „	of	2
Singing	1 „	of	2	Gymnastics	1 „	„	2
Dressmaking (higher course)	1 „	„	2	Dressmaking (lower course)	2 „	each	2
Machine Sewing	5 „	each	2	Ironing	2 „	„	1½
Cooking	1 „	of	4½	Fröbelian Occupations ...	1 „	of	2

There are altogether 36 courses in the Evening School.

In

[1] Till 7 p.m. is reckoned as afternoon (*Nachmittags*), and later, evening (Abends).

[2] Also a higher course of 2 hours per week.

In the *Day School* the subjects of instruction are :—

Subjects.		Hours per Week.
German	6 courses, each	2
English	6 „ „	10
Commercial Arithmetic ...	5 „ „	2
Counting-house Practice and Commercial Science ...	1 „ of	2
Stenography	5 „ each	2
Needlework	1 „ of	4
Professional Needlework ...	2 „ each	2
Industrial Drawing	3 „ „	4
Dressmaking (Upper Course)	of	4
„ (Lower Course)	„	4
French	6 courses, each	18
Book-keeping (single entry)	1 „ of	1
„ (double entry)	3 „ each	1½
Commercial Caligraphy ...	3 „ „	2
Typewriting (instruction on six different machines)	...	30
Typewriting (weekly practice)	...	30
Art Needlework	2 courses, each	2
Millinery	1 „ of	4

The Fortbildungsschule in Auguststrasse.—In this school the fees are :—

One mark (1s.) per month, to be paid in advance.
For Dressmaking and Millinery, 1 mark (1s.) each per month.
For Dressmaking and Millinery alone, each 2 marks (2s.) per month,
For French, extra, 1 mark (1s.).
July and August being vacation months, no school fees are charged.

The subjects of instruction are the following :—

Subjects.		Hours per Week.	
		Evening.	Afternoon.
German	2 courses, each	1	1 course of 1.
Arithmetic	3 „ „	1	
Book-keeping	1 „ of	2	
Needlework	1 „ „	3	
Machining and Cutting-out	1 „ „	3	
„ „	2 „ each	2	
Dressmaking	4 „ „	3	
Millinery	2 „ „	......	1 course of 2.
French	2 „ „	2	
Stenography	2 „ „	1	

Commercial and Industrial Continuation Institution for Young Women.—In this institution the fees are :—

For German, Arithmetic, Needlework, and Singing, 1 mark (1s.). (Day course—Arithmetic and German, 1·50 marks (1s. 6d.); Needlework, 1 mark (1s.); Singing. (free). For Drawing, Cutting-out, Machining, Millinery, 1 mark (1s.) each; for Art Needlework, Ironing, Book-keeping (single and double entry), 1·50 marks (1s. 6d.) each; for English, French, Dressmaking, Painting, 2 marks (2s.) monthly; for Writing and Gymnastics, 1 mark (1s.) per quarter; Typewriting, 6 marks (6s.)

The subjects taught are the modern languages, viz., German, French, English, Arithmetic, Drawing, Singing, Needlework, Cutting-out, Machining, Dressmaking, Ironing, Millinery, Book-keeping, Gymnastics, Stenography, Typewriting, and Caligraphy. The instruction is given in the afternoons and evenings. The time devoted thereto is very similar to the preceding case.

Commercial School and Commercial Continuation Institution for Girls in the Dorotheen Municipal Realgymnasium.—The fees in the Commercial School are as follows :—

In the two first half-years for the five obligatory subjects...	15	marks	(15s.) quarterly.
Writing and Stenography, each	3	„	(3s.) „
English and French, each	5	„	(5s.) „
In the *third* half-year for the five obligatory subjects ...	10	„	(10s.) „
English and French, each	3·50	„	(3s. 6d.) „
Writing and Stenography, each	2	„	(2s.) „

For the *Continuation Institution* they are :—

For one subject...	5	„	(5s.) „ „
For two subjects	8·50	„	(8s. 6d.) „
For three subjects	11	„	(11s.) „
Members of the Union pay for one subject	3·50	„	(3s. 6d.) „
„ „ two subjects	5	„	(5s.) „
„ „ three subjects	7	„	(7s.) „
„ „ four subjects	8	„	(8s.) „

The Subjects of Instruction in the Commercial School are—German, German Correspondence, Writing, Arithmetic, Business Science and Account Practice, Book-keeping (single entry), Book-keeping, by Double Entry, Commercial Geography, English, French, Stenography, Typewriting.

The subjects of instruction in the *Continuation School* are the same, the distribution of time being slightly different.

10. *Municipal Continuation Schools for the Deaf and Dumb.*—The aim of these schools is to enable adult deaf mutes, who have already learnt audible speech, to acquire, through regular practice in speaking and observation, ability to enter freely into conversation, as well as to secure and supplement their school education.

The instruction is gratuitous, and is given only in the evenings.

For young men, 4 courses each.

Reading and German	2 hours per week.
Arithmetic	2 ,,

For young women, 2 courses each.

Reading and German	2 hours per week.
Arithmetic	1 hour ,,
Needlework	2 hours ,,

11. *The Industrial Educational Institutions of Berlin.*—The Industrial Educational Institutions of Berlin consist of the following schools, viz.:—

1 Municipal Weaving School.
2 Artisan Schools.
1 Engineering School.
The Municipal Industrial Hall.
Mechanical Engineering School.
Berlin School for Cabinet-makers.
20 Special Trade Schools.

12. *The Higher Municipal Weaving School, Berlin.*—This school is maintained by the State, the City, and the subscriptions of persons interested in the textile industry, the Senior Merchants' Association, and the Guild of Loom-workers.

The Weaving School is placed under a "Kuratorium," constituted as follows:—

(i) Nominees of the Minister;
(ii) Representatives of the Industrial "Deputation";
(iii) ,, ,, City Council;
(iv) ,, ,, Senior Merchants' Association;
(v) ,, ,, Textile Union;
(vi) ,, ,, Guild of Loom-workers; and, finally,
(vii) The Director of the Weaving School.

The scheme of instruction embraces weaving, designing of patterns, lace and passementerie making, embroidery, and dyeing. It is given in day, evening, and Sunday classes. The day classes serve for the education of manufacturers, directors of manufactories, and designers of patterns, and also for the education of embroiderers. The evening and Sunday classes are for the education of merchants, and are also continuation schools for journeymen, apprentices, and embroidery workers.

In the weaving course, the wool and the "half-wool" industry (material for making up and trimming, bands, fabrics, quilts, furniture material, and carpets) are chiefly dealt with. Other textile materials are included, in so far as it is consistent with the principal aim of the institution.

The *Dyeing Course* is limited in the introductory stages to lectures and laboratory practice in dyeing, but it does *not* include experiments on a large scale.

The *Conditions of Admission* are that the applicant shall be over 16 years of age, and shall have had at least such education as that afforded in the highest class of a real-school, possessing as far as possible a good knowledge of the practical rudiments. Girls may enter the courses for pattern designers and embroiderers, for which the age of admission is often only 14 years of age. After the beginning of any course, pupils will not as a rule be admitted, and they must in all cases submit to the discipline of the establishment.

The *School Fees* in the *day class* are different for Prussians, Germans generally, and foreigners. They are as hereunder:—

	Prussians.	Germans.	Foreigners.
	Yearly.		
	Marks.	Marks.	Marks.
(1) For full scholars—Spinners, weavers, lace and passementerie makers, dyers	200	300	800 (shillings)
Pattern designers	60	60	800 ,,
Embroiderers pay quarterly 50 marks.			
(2) For irregular students for each weekly hour	30	50	100 ,,

In the *Evening and Sunday Classes*, the fees are:—

(1) For merchants (for a course of six weekly hours), 30 marks yearly.
(2) For dyers, 30 marks yearly.
(3) For pattern designers, embroiderers, and others who participate in the general instruction for each weekly hour, 6 marks yearly.
(4) The instruction for journeymen and for apprentices in spinning, weaving, and lace or passementerie making, who live or are in employment in Berlin, and also for those who, belonging to a foreign guild or union, are admitted by the unanimous consent of the "Kuratorium" of the school, is gratuitous.

The

The school fees must be paid half-yearly in advance, with the exception of the embroiderers of the day-class, who are expected to pay quarterly. Return of fees is made only exceptionally and with the approval of the school authorities, and only when the student has been obliged prematurely to leave the institution through no fault of his own. Assiduous and needy Prussian pupils may have their school fees remitted wholly or in part.

13. *Details of the Courses.*—All the courses, with the exception of the Commercial, begin at Easter and Michaelmas. The Commercial courses, however, begin only at Michaelmas.
The instruction given in the day-school has the following five main divisions :—

I. *Spinning, Weaving*, etc., which is again divided thus :—
 (*a*) A course for Manufacturers and Directors of Factories of one year's duration (for those who desire only improvement in certain branches), and of one and half years' duration for those who wish also to learn rug-making, carpet-making, and the making of upholstering material.
 (*b*) A course for designers of patterns, lasting two years.

II. *Weaving*, one year's duration.

III. *Lace and Passementerie* making, one year's duration.

IV. *Embroidery*, three months' duration.

V. *Dyeing*, one year's duration.

In connection with Division I (*a*), the subjects taught are the general theory of weaving, etc. of sketching out patterns; the theory of materials; the theory of mechanism, including hand-weaving, motors and their power, machine preparations, mechanical loom; practical exercises; freehand drawing and pattern designing, geometrical and mechanical drawing and sketching; special or professional arithmetic and book-keeping; theory of dyeing; commercial and industrial law.
The following table will give an indication of the time devoted to each subject :—

Subjects.	Hours per Week.		
	1 Sem.	2 Sem.	3 Sem.[1]
The Theory of Weaving, etc. ...	6	6	......
Pattern Designing ...	12	12	14
Theory of Materials ...	2	......	......
Mechanics—			
Hand-loom ...	2	......	......
Motors, including elements of machinery...	2	......	......
Preparatory operations ...	......	2	......
Designing Machine ...	......	2	2
Mechanical Loom ...	......	4	2
Practical Work ...	9	8	8
Drawing—			
Freehand Drawing and Pattern Designing ...	2	2	14
Geometrical and Mechanical Drawing and Sketching ...	3	3	......
Professional Arithmetic and Book-keeping ...	3	2	......
The Theory of Dyeing ...	2	2	2
Commercial and Industrial Law...	1	1	......
Recapitulation ...	......	......	2
	44	44	44

The Director decides the hours of instruction for pattern-designing, drawing, practical exercises and instruction in the theory of dyeing, and regulates these for individual scholars so as to accelerate their improvement. But the total number of weekly hours, set apart for these four subjects, are not to be diminished by these arrangements.
In connection with I (*b*), the subjects taught are :—

(1) *Professional Drawing.*—Drawing of objects in outline, and in various tones; drawing and painting from samples; the arrangement and design of new patterns. Drawing and painting from plastic models, with colour-treatment in body-colour and contrasted tones; building up and designing new patterns, with more plastic and effective motives. Drawing and painting from Nature.

In addition, some of the patterns designed are completed.

(2) The theory of weaving.
(3) The development and selection of patterns.
(4) Loom practice.
(5) Theory of materials, and
(6) Mechanics, with special reference to weaving machines.

The

[1] Only for pupils of the fabric covering, upholstering, and carpet branches.

The following table will indicate the time devoted to each subject in Weaving (*Weberei*) :—

Subjects.	Hours per Week.			
	1 Sem.	2 Sem.	3 Sem.	4 Sem.
Professional Drawing	22	22	24	24
The Theory of Weaving	6	6	......	......
Development and Selection of Patterns	6	6	12[1]	12[1]
Practice with the Loom	6	6	6	8[1]
Theory of Materials...	2	......	......	......
Mechanics (Hand and Mechanical Loom)	2	4	2	......
	44	44	44	44

In Division II, Weaving (*Wirkerei*), the programme of instruction is as follows :—

Subjects.	Hours per Week.	
	1 Sem.	2 Sem.
Decomposition and Composition of Fabrics	4	4
Practical exercises on the Weaving-loom	16	16
Theoretical lectures on Weaving	2	2
Theory of Weaving	6	6
Pattern development and selection...	2	4
Theory of Materials...	2	......
Mechanics (Hand-loom, Motors, "Appreturmaschinen")	4	2
Practice on the Weaving-loom	2	2
Professional Arithmetic and Book-keeping	3	2
Drawing (Mechanical Drawing)	......	3
Theory of Dyeing	2	2
Industrial and Commercial Law	1	1
Total	44	44

It will be observed that some of the subjects are identical with those specified under "*Weberei.*" The same teaching is deemed to be necessary for the students of "*Wirkerei.*"

The following is the programme for Division III :—

Subjects.	Hours per Week.	
	1 Sem.	2 Sem.
The Theory of Weaving	6	6
Pattern development and selection...	8	8
Theory of Materials	2	......
Mechanics	4	8
Practice	12	12
Professional Arithmetic and Book-keeping	3	2
Drawing	6	5
The Theory of Dyeing	2	2
Commercial and Industrial Law	1	1
	44	44

The practical exercises have regard to ordinary handwork, in connection with the frame, the renewal of the cords, etc., the setting up of hand-looms for lace and passementerie work, the bobbin, hook, and chenille machines, the gimp and ribbon mills, and all subsidiary apparatus.

In *Division IV*, the subjects of instruction are :—

(1) Practical instruction with an embroidery machine, 32 hours a week being devoted thereto.

(2) *Drawing.*—Drawing from objects, with a view to cultivating the form-sense, copying from examples of embroidery, from decorative as well as passementerie embroidery. Working up given motives into serviceable patterns, free designs, and the theory of colour harmony. Four hours a week are devoted thereto.

In

[1] These hours can also be utilised for Sketching and Pattern-designing.

In Division V, Dyeing (Färberei), the programme of instruction is as follows :—

Subjects.	Hours per Week.	
	1 Sem.	2 Sem.
Chemistry and Physics	4	4
Chemical technology of textile fibres	2	2
Dyeing and chemical laboratory practice	33	33
Fundamental outlines of Weaving	2	2
Applied Mechanics (Motors, "Appreturmaschinen")	2	2
Industrial and Commercial Law	1	1
	44	44

14. *Evening and Sunday Classes in the Weaving School.*—The instruction given in the Evening and Sunday classes is divided into the three courses as follows :—

I. Commercial Course, lasting one year.
II. Dyeing Course, lasting two years.
III. Instruction for spinners, etc., pattern designers, weavers, passementeric and lace makers, embroiderers and others (according to the requirements of the students).

In Course I, the subjects of instruction are the following :—

(1) (*a*) The raw materials ; (*b*) the process of manufacture ; and (*c*) the finished materials ready for market.

In (*a*) the various raw materials used in spinning and weaving are described, their isolation and cleansing, the processes of washing, bleaching, carbonising, etc. The principal markets for trade in the materials, and the factors determining their price, are indicated.

In (*b*) the preparation and spinning of the raw material are dealt with ; some indication is given of the essential features of the construction of the spinning machines, of the methods, the distinguishing quality and staple, of testing the strength of the raw material. The differences between various forms of weaving (between "gewebten Waaren und gewirkten Waaren"), the principal forms of hand and mechanical weaving machines, the ordinary and the Jacquard looms, the dyeing of the raw material, the most important of the dye materials, the method of determining their tinctorial value, dyeing and printing, etc., form also subjects in the lectures.

Under the third division (*c*), full descriptions are given of various fabrics, according to their material, colour, and texture. They are also described according to the fundamental differences in modes of weaving. The means of testing their strength and quality, calculations of value, and the principal places of manufacture are also described.

(2) Development and selection of patterns.—The object of this instruction is to furnish a satisfactory basis for dealing intelligently with the commercial side of the subject. Pupils are instructed in various types of woven goods, and are taught how to make a rough estimate, having reference to material employed, etc. They are thus exercised in all questions relating to cost price.

(3) *Weaving practice.*—The course in practical weaving shall facilitate the pupil's understanding of the progress of weaving and the raw materials, and shall also enable him to readily perceive the most frequently occurring weaving defects. Less importance is attached to the attainment of technical dexterity.

The following table will indicate the time devoted to each subject ;—

Subjects.	Hours per week.	
	1 Sem.	2 Sem.
Knowledge of merchandise (Sunday, 9–11)	2	2
Pattern development and selection (Sunday, 11–1)	2	2
Weaving practice (Monday or Thursday evening, 8–10) ...	2	2
	6	6

For

For *Course II* (Dyeing) the programme of instruction is:—

Subjects.	Hours per Week.	
	1 Sem.	2 Sem.
Chemistry and Physics	2	2
Chemical technology of textile fibres	2	...
Dyeing Laboratory practice	2	4
	6	6

This instruction is given from 8–10 on Thursday evening and from 9–1 on Sunday.

The programme for Course III is as follows:—

Subjects.	Hours per Week.
Hand-loom practice	2
Decomposition and composition of textile fabrics	2
Theoretical and Practical Mechanics on weaving machines	2
Exercises on the hand-loom	2
Professional drawing (model drawing and pattern designing)	4
Decomposition of textile and lace and passementerie fabrics	4
Practice on the hand-loom	4
Practice on the power-loom	4
Practice on the hand-loom and the weaving machine	4
Practice on the hand-loom and machine for lace and passementerie making	4
Practice on the winch stitching-machine (all systems)	4

Examinations and Diplomas.—The students of the Manufactory and Directors of Factories and the Commercial courses may undergo a Leaving-Examination. The modifications of the Examination regulations prevail for this examination.

To pupils of these two courses who do not submit themselves to the Leaving-Examination, Diplomas are not awarded, but Certificates only, stating the period of attendance at the school, with the express observation that they did not submit to the examination.

Pupils of the other courses receive half-yearly Diplomas for good behaviour, diligence, and work.

Irregular students receive, as a rule, only a Certificate of the Directors, stating the length of attendance at the school and the kind of instruction received, with the express observation that they were only irregular students.

15. *The Artisan Schools.*—There are two of these schools, one situated in Linden-street and the other in Andrea-street. They are maintained by the City, with State subsidies.

The object of the first school is to give to apprentices and assistants of the industrial classes, preferably, in their leisure hours, technical, technological, and scientific higher instruction, as well as workshop practice, and also to fit them for the more advanced stages of their respective spheres. Admission may be obtained by everyone above the age subject to compulsory education, if they have attained to the limit of instruction of the Communal school.

The instruction is given daily in the afternoon and evening, including Sunday afternoon. In the Trade-school for Mechanics, and the special day-classes for Electro-technics, Carpenters, Painters, and Modellers, which are included in the First Artisan School, the instruction is given daily, excluding Sunday.

The selection of subjects is left to the discretion of the pupil, *provided that he possesses a satisfactory knowledge of the necessary rudiments.*

16.

16. *First Artisan School.*—The following is the curriculum of the First Artisan School for the Winter Semester, 1901–1902; the programmes for the Special *day*-classes being given later on:—

Monday and Thursday.	Tuesday and Friday.	Wednesday and Sunday.	Sunday.
P.M. (4–6.) Electro-technics. Chemistry and knowledge of articles for druggists. P.M. (5–7.) Freehand Drawing. Drawing from Vegetable Life. Compass Drawing. Perspective Drawing. Descriptive Geometry. Professional Drawing for Mechanics. Algebra, 1, 2, and 3. Geometry. Mathematical Exercises (6–8). Higher Mathematics (Thurs. 6–7). P.M. (7–9.) Freehand Drawing. Figurative Drawing. Pose Drawing. Compass Drawing. Perspective Drawing. Descriptive Geometry. Shadow Construction. Perspective. Professional Drawing for— Joiners. Smiths, Locksmiths. Mechanics. Braziers, Ironworkers. Painters. Typographers. Mercantile lithographers. Modelling. Decorative Arts. Algebra, 1 and 2. Geometry. Trigonemetry (8–9). Mechanics. Physics.	P.M. (3–5.) Freehand Drawing. Water-colour Drawing. P.M. (5–7.) Freehand Drawing. Water-colours. Compass Drawing. Projection Drawing. Technical Drawing for Mechanics. Algebra, 1, 2, and 3. Geometry. P.M. (7–9.) Freehand Drawing. Figurative „ Pose „ Compass „ Projection „ Descriptive Geometry. Shadow Construction, Perspective. Technical Drawing for— Carpenters. Tinkers. Mechanics. Braziers, Ironworkers. Painters. Upholsterers and Decorators. Typography. Modelling. Decorative Arts. Algebra, 1, 2, and 3. Geometry. Physics. Chemistry.	P.M. (5–7.) Freehand Drawing. Compass Drawing. Projection Drawing. Mechanics 3 (6–7). P.M. (7–9.) Freehand Drawing. Figure „ Compass „ Projection „ Descriptive Geometry. Technical Drawing for— Mechanics. Masons. Carpenters. Painters. Theory of Industrial Art Forms. Modelling. Arithmetic. Algebra, 1, 2, and 3. Geometry. Book-keeping. Electro-technics. Electrical Installation (Wed. 7–9).	A.M. (8–9·45.) Freehand Drawing. A.M. (8–12.) Special Class for Typographers. A.M. (9–1.) Technical Drawing for— Joiners. Turners. Tinkers. Locksmiths. Smiths. Mechanicians. Mechanics. Electro-technologists. Watchmakers. Gold and Silver smiths. Engravers. Braziers. Ironworkers. Masons. Carpenters. Stonemasons. Painters. Upholsterers and Decorators. Lithographers. Ornamental Drawing. Figure and Technical Drawing. Water-colour Drawing. Modelling. Decorative Arts.

The particulars of the Mathematical Course are:—

Arithmetic (Two courses, two hours a week each).—Commercial arithmetic. Calculation of areas and volumes. Plane figures. The surfaces and contents of bodies. For development: Solution of problems by various rules. Exercises concerning the employment of mathematical tables.

Algebra.—Three graduated courses in ten divisions, two hours a week each.

1*st Course.*—The four kinds of fundamental operations with whole and fractional numbers with regard to general dimension. Simple equations of the first degree.

2*nd Course.*—Algebraic calculation. Equations of the first degree, with one and more unknowns. Powers with whole positive exponents.

3*rd Course.*—Powers with general exponents, radicles, equations of the second degree. Logarithms.

Geometry.—Three graduated courses in ten divisions, each two hours a week.

1*st Course.*—Plane geometry: Triangles, parallelograms, and circles.

2*nd Course.*—Comparison of areas. Similarity of regular polyglons, calculation of circles.

3*rd Course.*—Position of straight lines and planes. Solid bodies, areas, and contents of same.

Trigonometry.—Two courses, each two hours a week. Calculation of plane figures.

The Special School for Mechanics (1st Artisan School.)—The aim of this school is to promote the theoretical education of mechanical assistants, so that they may qualify as laboratory assistants, managers of works, or directors of mechanical establishments, etc., and efficiently perform the duties of their respective spheres. At the same time it affords a basis for more advanced studies in the special direction of practical mechanics and electro-technics.

The course continues for one year, and begins in October. Participants who leave the class after the first half-year receive, on application, a certificate of the half-year completed.

The programme of instruction is as follows:—

First Semester. Subjects.	Hours per Week.	Second Semester. Subjects.	Hours per Week.
Mathematics	5	Mathematics	2
Physics	6	Physics	5
Physico-mathematical practice	2	Physico-mathematical practice ...	2
Chemistry	4	Chemistry	2
Technical Mechanics	2	Technical Mechanics	2
Knowledge of instruments	4	Knowledge of Instruments ...	4
Electro-technics	4	Electro-technics	4
Technology	3	Technology	3
Drawing	13	Drawing and Designing	13
		Physical laboratory practice ...	5
Total	43	Total	42

The Entrance Conditions.—The following are the conditions of admission:—

1. The pupils must have performed a three-years' apprenticeship in an electro-technical factory, a mechanical or watch-making establishment, in a machine factory, locksmith shop, or in some similar establishment, and have been employed therein as assistants. In exceptional cases a brief practical career, preceded by thorough theoretical instruction, is regarded as adequate.
2. They must possess ability to express themselves in writing in a lucid manner. The composition should contain no gross orthographical errors.
3. In Mathematics, pupils must be familiar with calculations, with vulgar and decimal fractions, and the simple methods of arithmetic. They must know also the rudimentary operations of algebra, the solution of equations of the first degree to one unknown, and the elements of planimetry.

For admission to the second course, the requirements are identical with those of the first.

Day-classes for Electro-technics (1st Artisan School.)—The aim of the day-class for Electro-technics is to further the theoretical education of electro-technical assistants, so that they may be capable of creditably performing the duties of foremen, laboratory assistants, etc., in electro-technical factories and establishments. At the same time it gives a foundation for more advanced studies in the special direction of electro-technics.

The course is of one year's duration, and begins in October.

The students who leave after the first half-year may obtain, on application, a certificate of that half-year.

The following is the programme of study:—

First Semester. Subjects.	Hours per Week.	Second Semester. Subjects.	Hours per Week.
Mathematics	5	Mathematics	2
Physics	6	Physics	4
Mathematical exercises	1	Mathematical exercises	1
Chemistry	4	Chemistry	2
Technical Mechanics	2	Technical Mechanics	2
Electro-technics	12	Electro-technics	14
Drawing	8	Motor-engines	2
Physical laboratory practice	6	Drawing and Designing	9
		Physical laboratory practice and excursions	9
Total	44	Total	45

Day-classes for Joiners (1st Artisan School).—These classes afford opportunity for the acquisition of that knowledge and skill in drawing which every assistant, foreman, designer, or director of a cabinet-making establishment should have, for the correct comprehension and execution of a design or plan.

They arrange, moreover, for more extensive instruction in the planning and designing of furniture, architectural designs, and interior decorations.

The classes have two divisions, viz., a lower and an upper. Forty-two hours a week are given to the theory and practice in each.

The subjects of instruction are:—

Lower Division.—Compass and projection drawing, shadow construction. Ornamental drawing and designing of simple ornaments. Drawing of architectural decorative forms, with illustrative lectures. *The theory of forms.*—The dimensions and forms of furniture and architectural designs (Lectures and sketching practice). Measuring and designing of separate pieces of furniture and of the whole furniture. Construction of designs for work, planning of simple furniture and architectural ornamentation. Book-keeping.

Upper Division.—Drawing and designing of ornaments, shadow construction. Perspective. Drawing and designing of furniture. Architectural ornamentation and interior decorations in the most heavy styles. Making estimates.

For entrance to the Upper Division, the certificate of competency for the Lower Division is requisite.

The instruction is given in the summer and winter semesters, which begin in April and October. Pupils may be admitted in either month.

Day

Day classes for Painters.—(1st Artisan School).—These classes afford assistants, during four winter months, opportunity for constant improvement in Drawing and Painting, for gaining acquaintance with the varieties of technique, and obtaining practice in sketching and designing.

New students, whose knowledge of drawing is limited, delineate, at first, ornaments on the flat and then paint them in water-colours; drawing from plastic ornaments in outline, the execution of designs in white and black crayons, and plastic painting in grey shades follow.

Students who have reached the requisite standard in these studies, or who have formerly attended Painting or similar schools for apprentices, begin with drawing and painting from plastic ornaments with colour-treatment; by this means they will, as far as possible independently, be accustomed to develope harmonious colour-tones. Advanced art students who have already given satisfactory evidence of their knowledge, and whose artistic sense is more thoroughly educated, take lessons in the preparation of working drawings or traced drawings for parts of ceilings, walls, etc., and the development of paintings of life-size proportions from sketches and decorative designs.

Particularly talented students are engaged in the preparation of sketches in water-colours and with the completion of larger decorative designs, having reference to figurative designs, and they also practice painting from Nature (still-life, flowers, tapestry, etc.) in various techniques.

On several afternoons flowers and plants are sketched and painted, their application to decorative art and ornamental design being demonstrated.

The instruction begins in November and terminates in February. Entrance may be allowed at any time.

Day classes for Modellers.—(1st Artisan School).—These classes meet only in the winter semesters, and are for the special benefit of those wood-carvers, modellers, engravers, designers in iron, etc., who desire to attain such skill in modelling (in clay and wax) as would enhance the value of their work.

The ornamental modelling serves as a basis for each further development to be executed from plastic models, photographs, and drawings; the advanced pupils will be initiated into the creation and execution of designs for plastic ornaments, vases, tools, and the like, consideration being given thereby to the study of natural forms and their application in ornamental design. Instruction is given in the technique of Plaster-of-Paris designs, now largely demanded in the finishing of buildings, especially as regards the interior decorations.

Figure modelling is at first studied from Plaster-of-Paris models and natural casts; the advanced students practice portrait and pose modelling (from life) every afternoon.

The final aim of the modelling class is to make students expert in the execution of decorative and industrial-art designs with harmonious combination of figure and ornament.

Forty-four hours a week are devoted to these studies, the instruction commencing in October. Entrance, however, can take place at any time during the winter semester.

Special Classes for Typographers.—(1st Artisan School).—These classes are intended for the industrial-art and technical education of printers' assistants. The instruction, beginning in April and in October, is of at least two half-year's duration, and in the winter semester, 1901, comprised the following divisions:—

Division A (Sunday from 8 to 12 a.m.)—Designing and sketching of printing apparatus (1st Part). The theory of colour. The principal features of the typographical work, including typographical ornament and its application, the theory of colours, the technique of colour-systems, colour-printing, etc., are explained by lectures and practical exercises.

On Monday and Thursday, from 7 till 9 p.m., the work is as follows:—

Drawing of founts, ornaments, and vegetable life. Exercises in designing. Theory of style.

Division B (Tuesday and Friday from 7 till 9 p.m.)—Designing and sketching of printing apparatus (2nd Part).

Book-printing, job-printing, advertisement work, etc., are the subjects of the lectures and practical exercises.

Division C (Sunday from 8 till 12 a.m.)—Theory (Lectures, demonstrations and practice.)

(1) From 8 to 10.—Applied mechanics. Modern machine-construction. The printing of illustrations. Setting up.

(2) From 10 to 12.—Cutting of plates in metal and other material.

The evening classes of the Artisan School afford an opportunity for education in various branches of Drawing, in Compass and Projection Drawing, in Shadow-construction and Perspective, in Mathematics, Physics, Mechanics, Chemistry, Arithmetic, and Book-keeping.

Punctuality of attendance is strictly insisted upon.

At the conclusion of each semester, certificates are awarded.

The school fees must be paid in advance. The terms per half-year are:—

Evening and Sunday Courses.

	Marks (or shillings).
For 8 or less than 8 hours per week	6
„ 9–12 hours per week	9
„ 13 and more weekly hours	12
„ the course on electrical installations	6

Special and Day Classes.

For the school for Mechanics (half-year)	60
(This fee includes admission to the Evening and Sunday courses.)	
„ the Day-class in Electro-technics (1st half-year)...	100
„ each additional half-year	60
(This fee also includes admission to the Evening and Sunday courses.)	
„ the Day-classes for Joiners, Painters, and Modellers (monthly)	5

For the Special classes for Typography, the same as for the Evening and Sunday courses.

The instruction is free for pupils in poor circumstances, if the "Kuratorium" so approve.

17. *Second Artisan School.*—The object aimed at in this school is to give to apprentices and assistants of the industrial classes, preferably, the opportunity of obtaining, in their leisure time, instruction in drawing and scientific, technological, and industrial-mercantile instruction, and also supplementary practice in the workshop. All who are above the age subject to compulsory education, provided they have reached at least the limit of instruction of the Communal school, are eligible for admission.

The instruction is given in the afternoons and evenings.

The selection of subjects is at the option of the pupil, excepting that for those of a more advanced nature a knowledge of the necessary rudiments is required.

For the summer semester, the following is the programme of instruction :—

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Freehand Drawing	4	Mathematics—	
Compass Drawing	4	Algebra	2
Projection Drawing	4	Plane Geometry	2
Descriptive Geometry	4	Trigonometry	2
Professional Drawing (according to the profession)	4	Spatial Geometry	2
Theory of Industrial Art-forms... ...	4	Mathematical Practice	2
Modelling in Clay and Wax	4	Physics	4
Embossing in Metal and Iron	4	Mechanics	2
Practical exercises for Smiths in the theory of forms for wrought-iron ornaments	4	Estimation and sketching of the elements of Machines	2
Decorative designs and Designing from wood and marble imitations ...	4	Electro-technics	4
Painting from Nature	4	Chemistry	4
		Arithmetic	2
		Book-keeping	2
		Singing	2

This section comprises also the day-classes for braziers, smiths, and kindred arts and crafts, a preparatory class for beginners, and a day-class for painters.

The day-classes afford instruction and practice in the drawing and developing of ornamental designs in bronze, wrought-iron, etc., for illuminating and other fittings, gates, doors, and other fixtures, as well as for other branches of the mechanical arts. The classes meet daily from 8 a.m., the subjects taught being—Freehand drawing, designing of ornaments, architectural drawing, professional drawing, drawing and sketching practice. Descriptive geometry, the theory of ornamental forms, designing in bronze and wrought-iron work. The Preparatory class affords opportunity for youths entering business and those who have just left school, as yet undecided as to a profession, to acquire skill in drawing and sculpture so as to be able later on to come to a final decision with regard thereto. Further, for young men already engaged in the building trade, but hindered during the winter months from regularly carrying on their work, there are special or building-trade schools provided, having for their object a gradual training in drawing and sculpture. Instruction is given in compass, projection, freehand, ornamental, water-colour, and elementary professional drawing, modelling, and theory of ornamental forms.

The curricula for the day and preparatory classes are the following :—

Curricula of the Day-classes for Braziers, Smiths, and allied Arts and Crafts.

Monday.	Tuesday and Friday.	Thursday.	Wednesday and Sunday.
Hours, 8–12. Professional Drawing and Designing of ornamental forms. Hours, 2–5. Professional Drawing and Designing of ornamental forms.	Hours, 8–12. Professional Drawing and Designing of ornamental forms. Hours, 2–4. Architectural Drawing. Hours, 5–7. Theory of ornamental forms.	Hours, 8–12. Professional Drawing and Designing of ornamental forms. Hours, from 1·30. Sketching practice in the Museum and in the open air.	Hours, 8–12. Freehand and Ornamental Drawing, Designing of Ornaments, and Water-colours. Hours, 2–5. Descriptive Geometry, Perspective, Shadow construction.

The Preparatory Day-class.

Monday and Thursday.	Tuesday and Friday.	Wednesday and Sunday.
Hours, 8–12. Compass and Projection Drawing. Hours, 3–6. Ornamental Drawing (Monday). Water-colour Drawing (Thursday).	Hours, 8–12. Elementary Professional Drawing. Modelling in clay and wax. Hours, 5–7. Theory of ornamental forms.	Hours, 8–12. Freehand and Ornamental Drawing.

There

There are evening courses in connection with these classes for modelling, embossing in metal, the theory of forms suitable for wrought-iron ornaments, practical exercises in arithmetic, mathematics, physics, mechanics, chemistry, and book-keeping.

The Day-class for Painters (Second Artisan School) provides, during the four winter months, daily instruction and practice in freehand drawing, professional drawing, decorative designs, painting of wood and marble imitations, and designing of coloured decorations.

The school fees for the Second Artisan School, and all the classes connected therewith, are payable half-yearly in advance, and are as follows :—

	Marks (or shillings).
For 8, or less than 8, weekly hours	6
„ 9 to 12 weekly hours	9
„ 13 and more „ „	12
„ The day-class for painters, monthly	5
„ „ for braziers, smiths, and allied industries and preparatory class for novices in the industrial arts and crafts (half-yearly) ...	30

18. *The Civil Engineering School.*—The Civil Engineering School is under the joint administration of the State and the City. Its object is to provide suitable education for builders and contractors, etc., in theory of construction and matters relating thereto, and in drawing, designing, etc. It deals of course only with the lower grades of civil engineering.

The instruction in the institution is divided into four graded half-year Courses or Classes, as well as parallel classes; it is given in the summer and winter semester, 20 weeks in each, according to the following plan :—

Subjects.	Classes and hours per Week.				Total.
	IV.	III.	II.	I.	
German	2	...	...	...	2
Arithmetic	3	...	...	...	3
Algebra	4	4	...	...	8
Geometry, Trigonometry	4	5	...	...	9
Mathematical exercises	...	...	2	2	4
Physics	...	3	3	2	8
Land-surveying and levelling	...	...	2	...	2
The theory of building material	2	...	...	2	4
Statics, mechanics, the theory of elasticity	...	4	3	4	11
Descriptive Geometry	10	4	4	3	21
Building construction	13	15	12	7	47
Architecture...	...	3	4	6	13
Designing of buildings	...	...	10	12	22
Theory of form	4	6	6	4	20
Freehand drawing	6	4	...	...	10
Architectural police, Law	...	...	...	2	2
Builder's estimates, specifications, etc.	...	...	2	2	2
Book-keeping	...	...	...	2	2
Obligatory hours... ...	48	48	48	48	191
Modelling (optional)	2	2	2	...	...
First-aid Course (12 hours in the semester).					

The German is professionally orientated; it deals with the whole question of the technical forms of the language and business correspondence.

The Arithmetic is also illustrative of the forms occurring in technical practice.

The Algebra includes (Class IV) indices with positive exponents, first degree equations of two unknowns; (Class III) indices, roots, logarithms, arithmetical and geometrical series, interest, etc., and equations of 2nd degree.

The geometry, trigonometry, and stereometry include plane geometry, planimetry, solution of oblique-angled triangles, loci of lines and surfaces, volume and surfaces of prisms, cylinders, pyramids, cones, spheres, etc. Projective geometry and elementary perspective are also taken.

The theory of form commences with architectonic form-elements, and passing through the various types of architecture, and of façades.

Physics in Class III is divided into two sections, viz. (*a*), Liquid substances; (*b*), Gaseous substances.

Liquid Substances: Their compressibility, uniformity of the transmission of pressure, the hydraulic press, communicating vessels, surface-pressure, impulse, definition of specific gravity, areometer, water-wheels and turbines. Cohesion and adhesion of liquids, capillary tubes.

Gaseous Substances: Mariotte's Law. Weight of the atmosphere. Atmospheric pressure, barometer, manometer, suction-pump, force-pump, fire-engine, air-pump, lever, air-balloon. Diffusion of gases. *Heat:* Expansion. Coefficient expansion, thermometer, expansion of water. Gaseous bodies. The Mariotte and Gay-Lussac laws. Variation of state, the thermal unit. Heat of fusion and of evaporation. Cooling mixtures. Ice engine. Condensation of gases. Experiments with liquid carbonic acid. Elasticity of saturated steam, steam-engine. Specific heat. Diffusion of heat by conduction and radiation. Radiation and absorption of heat rays. Sources of heat. Mechanical equivalent of heat.

In

In Class II, the details of the Physics are as follows :—

Magnetism and Electricity: Elements of magnetism, magnetic field, lines of force, magnetic and diamagnetic bodies. Elements of frictional electricity, atmospheric electricity and lightning-conductors. Galvanic elements, action of currents on a magnetic needle. Galvanometer. Ohm's law. Legal units. Method of measuring currents of high potential electro-motive force and resistance. Ampèremeter and Voltmeter. Faraday's apparatus. Ampère's law, electro-magnetism and its applications. Electric and magnetic-induction. Induction apparatus, telephone, microphone, direct and alternating current. Generators and dynamos. Their limitations. Two and three phase currents, transformers, work equivalent, Voltampère. Joule's law. Incandescent and arc lights, description of various lamps. Chemical action of currents, Voltmeter. Galvano-plastics, polarisation. Accumulators. Morse's telegraphic apparatus.

In Class I, the course in *Physics* covers the following range :—

Acoustics: Velocity of sound through the air, transmission and extinguishing of sound through other bodies. Reflection and echo.

Optics: Rectilinear propagation of light, shadow formation. Camera Lucida. Intensity. The photometer. Velocity of transmission. Reflection plane, concave and convex mirrors. Place of image. The parabolic mirror. Refraction, construction of refracted rays, the angles of limit of refraction, total reflection. Refraction by plane-parallel plates and by prisms. Lenses, position of the images in the case of concave and convex lenses. Photographic apparatus. Structure of the eye. Arrangement of the microscope, astronomical, terrestrial and Galilean telescopes. Dispersion of colours through prisms, natural colour of bodies. Spectrum of the incandescent metallic vapours.

Other subjects are treated with similar fulness.

19. *The Municipal Industrial Hall* —The Industrial Hall aims at furnishing an education specially adapted to the needs of young mechanics and others belonging to the allied callings, viz, practical and electro-mechanicians, artistic and practical locksmiths, etc. It aims at providing, in fact, the necessary artistic and scientific knowledge and training which must supplement the workshop practice if excellence is to be attained.

The Sunday and evening classes are designed to enable apprentices and assistants who are already in employment to acquire skill in professional drawing and designing. Instruction is also given, as circumstances dictate, in mathematics, mechanics, and engineering, and in special modelling for ornamental locksmithing.

In the day-classes of the mechanical construction, school assistants willing to devote the whole year exclusively to theoretical instruction, may acquire the necessary knowledge for an engineering foreman, builder, etc.

The Sunday and evening classes are arranged in eleven analogous divisions in various parts of the city.

For each division programmes of lessons from the beginning of the half year are drafted.

This institution is governed by the "Industrial-Deputation,"

The Director must be a thoroughly qualified Engineer. He inspects the drawing rooms and the classes of instruction, examines the methods of teaching, recommends the equipment, and in general makes such provision that the Industrial Hall may satisfactorily meet the educational requirements of students.

For the regulation of the Institution in regard to external matters, such as the admission of students and the taking of inscription fees, the Rector of the Communal School is responsible, subject to the direction of the Division.

The students who are beyond the age of compulsory education, who no longer attend a school properly so-called, and who submit to the regulations of the Institution, are admitted to its Sunday and evening classes.

The inscription fees for the half-year are - for four courses of 1 hour each, 4 marks (4s.); for more than 4 hours, 6 marks (6s.). The School-Deputation may remit the fees in the case of poor students.

Respecting the range and aims of the individual branches of instruction for the Sunday and evening classes, the following items of information may afford a sufficient general idea.

Preliminary Course in Drawing (twenty-four courses of 4 hours per week each).—Preparatory practice, which must precede professional drawing, with a view to improving the education and accelerating the progress of the student. Exercises in the projection of simple objects with a view to developing spatial intuition. Construction of intersecting surfaces, and developments. The special calling of the student is taken into consideration in this course. The courses are arranged for working engineers, mechanics, and locksmiths, etc., and such separate courses in elementary drawing are all specially developed.

Professional Drawing for Engineers. (thirty-three courses of 4 hours per week each). Drawing of various parts of machines from models to scale. Freehand sketching from models, and construction of workshop designs from scaled drawings. Drawings from models, with variations. Pupils who possess the requisite skill in the foregoing, and who have completed the instruction in mechanics, are exercised in designing and drawing parts of machines. Execution of drawing in various styles. Design of machines.

Professional Drawing for Mechanics (twenty courses of 4 hours per week each).—Drawing of parts of instruments from models. Production of instructive workshop drawings of simple and then complex apparatus. Drawing apparatus, with variations. Exercises in sketching and in the independent design of typical parts of instruments. The design of implements and of apparatus, etc., belonging to scientific and mechanical departments, as well as of auxiliary apparatus, employed in mechanical technique.

Professional

Professional Drawing for Locksmiths. (nineteen courses of 4 hours per week each.)—The courses are as follows:—

For ordinary and artistic Locksmiths.—Drawing of details of simple mechanisms and locks of various construction, from models. Construction of these objects from prescribed measurements. Preparation of measured drawings. Execution of workshop drawings from given designs for iron doors, windows, safes, wardrobes, etc. Independent designs and sketches.

For artistic Smiths (artistic locksmiths).—Drawing of rosettes, leaves, tendrils, and construction of parts of lattice, etc., from models. Design of leaf models. Execution of workshop drawings from given designs in various kinds of styles. Separate designs and sketches of small and large appropriate objects.

For Working Locksmiths.—Drawing iron connections and constructive details from models. Scale drawings. Workshop drawings from given sketch designs, and calculations of strength of materials, etc. Designs and estimates, restricted to the easier examples of locksmith's construction. (One semester is devoted to instruction in the art of smithing)

Special Modelling for Artistic Locksmiths (four courses of 4 hours per week).—Modelling of such plastic details as occur in practice, and which are hardly appropriate or are unsuitable to be developed from drawings. Construction of models in "plastilina" or clay from iron models from drawings and sketches to natural scale.

Mathematics, Mechanics, and Engineering (eighteen courses, 2 hours per week each).—Elements of the theory of motion and equilibrium. Simple machines. Theory of elasticity and applications. Spur-wheels and mechanism generally. Practical examples of engineering computations. The most important examples of service to mechanicians and locksmith, and those engaged in the actual construction of machinery, are explained by technical problems in elementary mathematics. This illustrates how mathematics enter into practical work, and gives some facility in understanding its use.

In each division the subjects are distributed as follows:—

Division I.—Professional drawing for mechanics. Practical exercises for electro-mechanics. Professional drawing for working engineers. Professional drawing for locksmiths. This instruction occupies $3\frac{3}{4}$ hours on Sunday, and 4 hours during the evenings of the week.

Division II.—Professional drawing for locksmiths, engineers, and mechanics, 4 hours on Sunday morning. Professional drawing for locksmiths and the art of smithing, 8 hours during the week, in the evenings.

Preparatory grade for professional drawing—Sunday, 4 hours; week evenings, 8 hours per week.

Mechanics—2 evening hours a week.

Applied Mechanics—2 hours a week (evening.)

Division III.—Professional drawing for engineers.
" " locksmiths.
" " mechanics.
Sunday morning, 4 hours; week evenings, 4 hours.

Preparatory grade for professional drawing: Sunday morning, 4 hours.

Mechanics—2 hours a week, evenings.

Division IV.—Professional drawing for engineers, mechanics, and locksmiths; Sundays, $3\frac{3}{4}$ hours, morning.

Projection drawing, 8 hours a week, evenings; and $3\frac{3}{4}$ hours, Sunday morning.

Mechanics.—2 hours a week, evenings.

Division V:—Professional drawing for mechanics, engineers, and locksmiths—$3\frac{3}{4}$ hours, Sunday morning. Professional drawing for mechanics, engineers, and projection—drawing, 4 hours a week, evenings. Mechanics—2 hours a week, evenings. Mathematics—4 hours a week, evenings.

Winter half-year.—Professional drawing for mechanics, engineers, and locksmiths.

Projection drawing—Sunday, from 9 to $12\frac{3}{4}$ o'clock, morning.

Professional drawing for mechanics, for engineers. Projection drawing - 4 hours a week, evenings.

Theoretical mechanics—2 hours a week, evenings.

Mathematics—2 hours a week, evenings.

Division VI:—

(1.) Professional drawing for locksmiths—three courses of 4 hours per week each.
(2.) Professional drawing for engineers—five courses, one of 3 hours and four of 4 hours per week.
(3.) Professional drawing for mechanics—three courses of 4 hours per week each.
(4.) Modelling for forging, etc., and for locksmiths, engravers, etc.—4 hours per week, evening.
(5.) Projection drawing—three courses of 4 hours per week each.
(6.) Algebra—2 hours per week.
(7.) Theoretical mechanics—two courses of 4 hours per week each.

Division VII:—

Professional drawing for locksmiths, engineers, mechanics, and for artistic locksmithing—nine courses of 4 hours per week.

Professional drawing for adults—4 hours per week.

Theoretical mechanics—2 hours per week.

Preparatory grade for professional drawing—three courses of 4 hours per week each.

Modelling—4 hours per week.

Division VIII:—

Division VIII:—
Professional drawing for locksmiths—two courses of 4 hours per week each.
Professional drawing for engineers—two courses of 4 hours per week each.
Professional drawing for mechanics—two courses of 4 hours per week each.
Mechanics—two courses of 2 hours per week each.
Projection drawing—four courses of 2 hours per week each.
Modelling—two courses of 4 hours per week each.
Estimates—one course of 2 hours per week.

Division IX:—
Professional drawing for locksmiths—two courses of 4 hours per week each.
Professional drawing for engineers—two courses of 4 hours per week each.
Professional drawing for mechanics—two courses of 4 hours per week each.
Theoretical mechanics—one course of 2 hours per week.

Division X:—
Professional drawing for engineers, mechanics, locksmiths, in the preparatory course.
Theoretical mechanics—two courses of 4 hours per week each.

Division XI:—
Professional drawing for mechanics and the smithing art—three courses of 4 hours per week each.

20. *The School for Engineers in connection with the Industrial Hall.*—The object of the School for Engineers is to supplement the theoretical education of young engineers and others of like callings, after a completion of their apprenticeship, so that they might qualify as foremen, or technically proficient workmen, above the grade of ordinary workmen. It provides also a foundation for more advanced technical studies. A suitable preparation for the school guarantees to assistants a longer attendance at the evening and Sunday courses of the Industrial Hall or similar institutions. The greatest possible care is taken in the selection of teachers. In the visits of scholars to the factories, and in respect of the expressed wishes of the factory managers in regard thereto, every endeavour is made to work cordially and to develope a broad recognition of the ultimate value of the liberal regime by which technical education can be advanced. Proprietors and managers of factories in Berlin aim at assisting national technical education in every possible way, from patriotic motives.

Duration of the Instruction.—The course continues for one year and begins each year in October. The actual school-time, exclusive of holidays, is forty weeks. In the winter the hours of instruction are from 8 to 2 o'clock; in the summer, from 7 to 1.

Entrance Conditions.—To be admitted to the day-classes, students must:

(1) Give satisfactory evidence that they have served a three-years' apprenticeship as engineers, mechanics, or locksmiths.
(2) Have a good folk-school education, so that they are enabled to intelligently express themselves in writing, and without glaring grammatical errors.
(3) Possess some skill in drawing, and be able to solve equations (first degree with one unknown).

School Fees.—The school fees for the half-year are 50 marks (£2 10s.) payable in advance. The students are thereupon admitted to the evening and Sunday courses in each division of the Industrial Hall.

Certificates.—Each pupil, at the termination of the yearly course, receives a certificate defining his ability or the standard reached in each subject.

The curriculum is as hereunder:—

Subjects.	Hours per Week.	
	1 Sem.	1 Sem.
Mathematics and mathematical exercises	6	4
Physics	4	2
Chemistry	...	2
Technical mechanics	4	4
The elements of mechanical constructions and theory of machines ...	4	6
The theory of materials and of workshop practice	2	2
Electro-technics	2	2
General and mechanical drawing	14	14
	36	36

The following is a detailed account of the subjects of the curriculum:—

(1) *Mathematics and Mathematical Exercises.*—Recapitulation and practice in the ordinary forms of industrial calculation. Geometry, as far as the theory of proportion of lines, circles, etc. Stereometry, as far as the calculation of surfaces and volumes. Algebra, to the equations of the second degree with one unknown. Trigonometry, to the solution of right-angled triangles. Practice in the usage of various technical tables, and in calculation with logarithms.
(2) *Physics.*—In Physics, emphasis is laid on the exact observation of phænomena, on the elements of (i) mechanical theory of heat; (ii) magnetism (lines of force, etc.); (iii) the theory of electricity, with electrical measurements; (iv) and finally the use of the optical instruments, such as the photometer, angular reflector, telescope, microscope, levelling instrument and theodolite.

(3) *Chemistry.*—The elements of inorganic chemistry, with their applications to the technics of machinery.

(4) *Technical Mechanics.—The Theory of Elasticity.*—Tensile, compressive, and shearing strength will be treated as empirically known facts, and the methods for the determination of the co-efficients of elasticity will be illustrated. In the examination of the bending moments and transverse strength of materials, a case where the cross section is a simple form will be taken, so as to bring into relief the following, viz., the neutral axis, the axis of maximum stress, the moment of inertia, etc. These are all explained and illustrated by means of models and drawings, etc. In a similar manner, the resistance to torsion will be examined. An outline of the theory of compression is given, and the manner in which actual experiments can be explained is elucidated.

Statics.—Composition and analysis of forces and combined forces, levers, the weighing balance, centre of gravity, Guldinus' theorem, the elements of graphical statics, determination of stresses in simple constructions.

Dynamics.—Linear motion, velocity, acceleration, accelerating forces, dynamometer, conception of mass, mechanical work, *vis viva*, potential energy, combination of rectilinear motions, curvilinear motion, centrifugal force, the laws of friction and of resistance to motion, sliding friction, friction of body in motion, rolling friction, simple machines.

(5*a*) *Elements of Machines.*—Rivets and rivet joints, bolts and bolted structures, screws and screw connections, spur-wheels, friction wheels, belts, modes of transferring motion, cylinder axles, winches, eccentrics, couplings, pulleys, etc., piston and piston rod, the organs of a steam-engine, governors, pipes, their connection, and packing, valves and cocks, etc., etc.

The chief aim of the instruction is to give precision to the knowledge acquired as to the characteristic elements of machines, by special study and by exercises in mechanical drawing; to extend this knowledge by instruction in the mode of ascertaining the dimensions for practical construction, and by considering questions as to strength of parts subject to wear and tear and as to the limit of deformation under stress under various circumstances.

(5*b*) *Engineering.*—The most important machine tools, turning-lathes and their parts, gearing, drilling machine, milling machines, planing machines, machine tools for special purposes.

General theory of motors, fly-wheels, governors, steam engines, the state and distribution of steam with various forms of valves and various circumstances as to cut off and expansion, indicator diagram, and the brake dynamometer, discussion of the defects exhibited in the diagram, condensation, various forms of valve, compound engines, investigation of the steam engine, boiling and heating apparatus, fuel and its combustion, the most important fuels and their heat values, transmission of heat, chimneys, the most important boilers, flues, attention to boilers, laws relating to boilers. Hydraulic motors, water-wheels, turbines, various forms of pumps, relation between plunger and motion of water, influence of a long suction-pipe, valves, etc., sail-pumps, centrifugal pumps, lifting apparatus, pulleys, screw.jacks, winches, etc.; general, concerning hydraulic apparatus for raising loads.

(6) *Theory of Materials and of Workshop Tools.*—The nature of technically important metals, alloys, and other similar materials, especially various kinds of iron and steel. Their carbon contents and the various changes which they undergo in hardening, heating, tempering, cooling, etc. Generalities concerning the composition of inflammable substances, the atmosphere, etc., having regard to the process of combustion and the consequent generation of heat. Water and its natural impurities. Soft and hard alloys of various metals. Moulding and foundry-work. Explanation of the most important mechanical operations, and the tools necessary for them—for example, drilling, milling, planing, turning, etc., and the steel of machine tools. Cutting angles of steel tools, their nature and use, having regard to the best quality of work consistent with the smallest expenditure of time and force. Various forms of slotting, planing, milling, and similar machines. Accurate screw-cutting and manufacture of leading screw.

(7) *Electro-technics.*—Galvanic elements and accumulators, their action, etc. Internal and external work. Dynamo machines, the principal construction for continuous and alternating currents. Electrical units, their legal determination and method of measurement. Electro-motors and transmission of energy. Transformers. Electric lighting. Incandescent lamps and arc lamps. Wires, cables, etc., and their insulation.

(8) *Ordinary and Mechanical Drawing.*—The instruction covers the following ground, viz.: Theory of projections, drawing of parts of machines from models and detailed measurements, freehand sketches from models and preparation of instructive workshop designs from such dimensioned sketches, drawing from models, with variations, etc.

21. *The Berlin School for Joiners.*—The object of the "Berlin Joiners' School" is to provide suitable instruction in drawing and designing, in modelling and wood-carving, in dovetailing, framing, etc., on the use of tools, in style, and also instruction concerning the chemical treatment of wood used in joinery.

The instruction is given during the evening of ordinary week-days, and the morning and afternoon of both Sunday and Wednesday.

Divisions.—The school has a principal division and a number of subdivisions. In the principal division, instruction in every subject is given. The subdivisions include courses for professional drawing, the theory of joints, dovetailing, etc., and other subjects, as circumstances require.

The school fees per half-year are:—

For one course in professional drawing	4	marks	(4s.)
For each following course	2	„	(2s.)
For instruction in the other courses, inclusive of wood-carving ...	2	„	(2s.)

The "Kuratorium" exempts poor students from the payment of school fees, but the number of non-paying students is limited to one-tenth of the paying students.

Maintenance.—The school is maintained by the contributions of the Municipality, the Joiners' Guild, the Turners' Guild, and school fees.

 Administration.

Administration.—The school is under the control of the Industrial "Deputation," and is administered by a "Kuratorium," the members of which are elected by that body. A Commissioner of the "Deputation" presides; and the Director of the school is a member of the "Kuratorium," *ex officio.*

Direction.—The technical direction of the school is entrusted to a Director. It is his duty to visit the drawing-rooms and the classes, examine the methods of instruction, and to take care generally that the instruction responds to the educational needs of the scholars. He is the head of the teaching staff.

The supervision of the external arrangements, the admission of students, and the taking of school fees, are functions performed by an officer of the school, known as the "*Rektor.*"

All instructions regarding the utilisation of the schoolrooms, and also all orders issuing from the Rector, must be sanctioned by the "School Deputation."

Teachers.—The teachers are appointed by the Industrial Deputation, on the recommendation of the "Kuratorium." They are paid on an average 3 marks (3s.) an hour, but senior teachers may be granted an *honorarium* of 4 marks (4s.), and the teacher of chemistry 5 marks (5s.).

The School Regulations and Certificates.—The regulations of the school are printed and communicated to the pupils for their guidance, expulsion being the penalty for serious offence against them.

A certificate of attendance, etc., is issued to each pupil at the termination of the semester.

Programme of Study.

Part I.—First Half-year: Freehand drawing.
Second Half-year: Projection drawing.
Third and Fourth Half-years: Theory of joinery, framing, etc., and theory of form.
Fifth and Sixth Half-years: Professional drawing.

Part II.—Drawing from plastic ornaments.
Perspective and shadow construction.
Chemistry.
Modelling and wood-carving.

The courses for drawing from Plaster-of-Paris casts, Perspective and Shadow Construction, and Chemistry are half-yearly; there is no specified time for the course in modelling and wood-carving.

The *Chief Division* comprises twenty courses, which are as follows:—

Freehand drawing—two courses of $3\frac{3}{4}$ hours and 4 hours per week respectively.
Projection drawing—two courses of $3\frac{3}{4}$ hours per week each.
Drawing from Plaster-of-Paris casts—one course of 4 hours per week.
Theory of joinery, etc.—three courses of 3 hours per week each.
Professional drawing, preparatory classes—two courses of 2 hours and one of 3 hours per week.
Professional drawing—six courses, five of 4 hours and one of 2 hours per week.
Technology and knowledge of merchandise—one course of 8 hours per week.
Chemistry, Wood-staining and Polishing—one course of $1\frac{1}{4}$ hour per week.
Modelling and Wood-carving—one course of 4 hours per week.

There are eight subdivisions, the locality of instruction being situated in various parts of the city. The subjects and hours of instruction are similar to those in the Principal Division.

22. *The Special or Trade Schools.*—There are in Berlin quite a number of what may be called special schools for trade teaching. These are scattered over the city, not aggregated in one large building. The following sections will give some information in regard to them.

23. *The Special School for Masons and Carpenters.*—The object of the school for masons and carpenters is to supplement the practical training of apprentices and journeymen by such theoretical instruction and practice, and by such manual exercises as are necessary for developing efficiency in their callings, and which cannot be had under the limitations of the site of actual building-operations or in the workshop.

There is a preparatory drawing-class for masons and carpenters combined, and three graded professional drawing-classes for each, a class for instruction as to practical working conditions, and also a class for trade arithmetic with one or several parallel courses. Each class is assigned a special task (*pensum*) which, for the preparatory drawing-classes, the lower and intermediate professional drawing-classes, and the workroom science, is fixed for the half-year, and for the upper special classes, and the trade arithmetic classes, for each two half-years' study.

The classes are divided into summer and winter semesters, each of twenty weeks' duration.

The school-fees are paid in advance. For attendance at the preparatory classes, the special classes, and for practical instruction and instruction in trade arithmetic, the fees are five marks (5s.) per half-year.

For pupils who attend the Sunday drawing-classes, the practical instruction and instruction in trade arithmetic, is free.

Exemption from school-fees is recommended in the case of needy students.

Masons and carpenters, who are not regular pupils of the school, but who have been for one year employed at their trade, may avail themselves of the instruction designed to make good the special defects of the ordinary apprenticeship instruction. No abatement, however, is made with regard to fees in such cases.

Certificates and Promotions.—At the termination of each half-year, certificates are granted to the students, stating their ability, qualifications, application, and conduct, and stating also whether they are eligible for promotion.

First-Aid Course.—Instruction in first-aid is given, so that if accidents occur on the building sites or in the workshop, first-aid may be rendered pending the arrival of the doctor. The instruction is free and is given by a certificated doctor, and involves about fourteen one-hour lectures and demonstrations in all.

Administration and Teaching Staff.—The school is under municipal control, but the Guild of Master Builders, Masons, and Carpenters of Berlin, contribute annually toward its support.

The "Kuratorium" elects the Director of the school, *who performs the functions of his office gratuitously.*[1]

The teachers, as a whole, are practically trained and are master mechanics, or men of thorough technical training, who are familiar with all the details of masonary and carpentry. The

[1] Attention is directed to the public spirit here displayed.

The Programme of Instruction.

I. Sunday School.

Compass and Projection Drawing; Preparatory Class for Masons and Carpenters combined.—The duration of instruction is one half-year (twenty Sundays).

(1) The construction of various angles of commonly occurring magnitudes, construction of regular triangles and polygons, and various curves (semi-circle, segment of an arch, pointed arch, basket arch, ellipse and other arches), including the determination of the direction of the straight line normal or tangent to any point in a curve.

(2) Determination of centre of gravity of plane figures (triangles, square, regular, and irregular polygons). Determination of the centre-point of any segment of given spans and height.

(3) Explanation of simple bodies by means of models, drawing of such bodies in plan and side and end elevations, so that these ideas can be thoroughly grasped; cubes, quadrilaterals and pentagonal right and oblique prisms, right pyramid, right cylinder and sphere.

(4) Determination of oblique sections through certain of these bodies having regard to the subsequent execution of drawings of bevels, rabbeted and chamfered forms, diagonal sections, and other forms commonly found in architectural constructions.

(5) Vertical and horizontal sections through hollow bodies, and their representation in plan, side and end elevation. The object of these is to give a geometric basis for sections through openings in wall, etc.

(6) Drawing of simple sections such as are met with in roofs and arches in ground plan, side and end elevation. Construction of vertical and diagonal sections in positions commonly occurring in practice.

(7) Explanation of metrical scales. What is understood by natural magnitude? In what proportion to the natural magnitude and in what scale the various architectural drawings are usually prepared.

(8) How the scale of a drawing can be obtained.

Professional Drawing for Masons.

Lower class: The instruction is given during a half-year (twenty Sundays). Explanation of rules for bonding walls, illustrated on the drawing-board by means of models of stones.

There will be opportunity for practice in—

(1) The building of walls of various thicknesses with various bondings.
(2) The arrangement of door and window spaces, etc.; double walls with insulated spaces, etc.
(3) The construction of various arches with frames in plan, elevation, etc.
(4), (5), and (6) Various details of difficulty connected with window openings, balconies, cellars, and openings thereto, steps on staircases, etc.

Intermediate class: Duration of instruction, one half-year (twenty Sundays). The development of various forms of technical difficulty, arches, etc.

Upper class: Duration of instruction, two half-years (forty Sundays). In the first half-year there is a recapitulation of the more difficult elements of the work already done, then more difficult work in arches and groined vaulting, etc. In the second half-year the above work is still more developed. The construction of the ordinary staircases of large Berlin dwelling-houses, in brick, stone, etc., according to the building regulations, and similar work of an advanced character.

Special Drawing for Carpenters.

Lower class: Duration of instruction, one half-year (twenty Sundays).

(1) Explanation of timber work, taking the measurements of the buildings and making the flooring.
(2) Panelled partitions and the joints occurring therein.
(3) Flooring and alterations.
(4) Propping of flooring by horizontal joists, etc.
(5) Strengthening rafters and beams, etc.
(6) Double fastening for beams, wall-plates etc.

Intermediate class: Duration of instruction, one half-year (twenty Sundays). This is concerned mainly with roof construction.

Upper Class.—The first half-year is devoted to the more elaborate consideration of roof-construction, and to the cornices usually to be found in Berlin. In the second half-year the construction of wooden staircases are considered, including spiral staircases, balustrades for same, etc.

II. Evening School.

Practical Forms of Work on Site for Masons.—Duration of instruction, two half-years, with 4 and 2 hours per week respectively; boring, disposition of the bores[1]; marking out of the site for building; laying the foundation; scribing out the various forms of work; door, window, and plinth arches; the various matters involving attention in actual building; the use of special stones; their place in brickwork; the massive staircase; stone steps, etc.; treatment of a façade; building regulations demanding attention.

Practical Forms of Work on Site for Carpenters.—The course is designed to give the pupils a practical and thorough grasp of the work they would have to understand in building large houses, etc.

Professional Drawing for Masons and Carpenters combined.—Duration of instruction, two half-years, with 2 hours per week.

First Half-year.—Recapitulation and arithmetical exercises in vulgar and decimal fractions.

Linear measurement, surfaces, volumes, and weights of bodies.

Calculation of the perimeters and areas of rectangles, parallelograms, trapeziums, triangles, circles and practical application of same to floors, walls, roofs, etc., etc.

Calculation

[1] Trial holes, etc.

Calculation of quantities of materials for various works, the areas of which are measured in square metres.

Calculation as to how far a property is available for building; advanced computations.

Calculation of areas of solid and hollow prismatic bodies (walls, pillars, chimneys, floors, etc.), and of special building materials.

Second Half-year.—The instruction began only in summer of 1902, and hence was not developed at the time of the Commissioners' visit.

24. *School for Shoemakers.*—The school of shoemaking is maintained by the State, the City, the Union for Sunday Free Schools, and the Corporation. For apprentices, the instruction is free; journeymen or masters pay 1 mark (1s.) quarterly. There are two classes—in one the instruction is given on Sunday, from 9 till 12 a.m.; in the other, on Tuesday evenings, from 7 till 10.

25. *School for Painters.*—The school for painting is maintained by the State, the City, and the Corporation. Instruction is given every evening from 5 to 8, and daily from 1·30 to 4. On Sunday it is from 9 to 12, and is free for apprentices; assistants, however, pay 9 marks (9s.) per semester, or half-year. The subjects of instruction are drawing from Plaster-of-Paris casts, and from various models and objects, etc., both in outline and shaded.

26. *School for Barbers and Hairdressers.*—Maintained by the State, the City, and the Corporation.

School Fees.—Apprentices pay per semester for hair-cutting and hairdressing, 3 marks (3s.); for wig-making, etc., 3 marks (3s.); assistants, however, pay 6 marks (6s.) for each of these subjects; and for instruction in ladies' hairdressing, 15 marks (15s.); surgery, for assistants and masters, 15 marks (15s.).

Instruction in these subjects is given daily (Sunday excluded), between the hours of 2 and 6 p.m., excepting surgery, to which is devoted one evening in the week.

27. *School of the Saddlers', Harness, and Trunk-makers' Guild.*—The cost of instruction is 2 marks (2s.) per semester for apprentices, and 6 marks (6s.) for journeymen. There are Sunday and week evening courses in professional drawing, and lectures in the subject.

28. *School for Upholsterers.*—This school for upholsterers is maintained by the State, the City, and the Guild; and is divided into four classes of six hours per week, each with seven parallel classes, the details of which are as follows:—

In the 1st and 2nd classes, two hours per week are given to the various styles of upholstering decoration, two hours to professional knowledge, and two hours to professional drawing.

In the 3rd class, two hours per week are devoted to the decorative styles or other form of professional knowledge, and four to professional drawing.

In the 4th class, two hours and four hours per week are given to professional knowledge and professional drawing respectively.

The instruction in book-keeping is optional, and scholars of the 1st and 2nd classes may participate therein. It is given every evening, except Saturday, between 7 and 9, and on Sunday morning from 9 to 1.

Entrance—Conditions.

(1) Applications for admission must be presented to the Director during the currency of the instruction, and a notification, with account of apprenticeship and signed by the teacher, must be submitted therewith.

(2) Apprentices who have served half their apprenticeship have to apply for admission.

(3) Tapestry assistants have also to attend the special school, and the arrangement is made for such to complete all the subjects of instruction in one year.

(4) The school fees per semester are:—

  (*a*) Apprentices, 2 marks (2s.)
  (*b*) Assistants, 10 ,, (10s.)
  (*c*) Students of ability, who are in poor circumstances, are exempted from payment; they must notify the Director of their poverty.

(5) Should an apprentice desire to leave the school, the teacher has to notify the Director in writing and the reason of the step proposed. Regularity of attendance is insisted on, and irregularity is attended with punishment, according to the Regulations.

29. *School for Shoeing-smiths.*—There are two classes in professional drawing on Sunday morning, from 10 to 12, and one class in theoretical instruction in shoeing on one evening in the week, from 7 to 9.

30. *School of the Glaziers' Guild.*—The Glaziers' School is really maintained by the State, the City, and the Guild. Apprentices are admitted free; journeymen pay 5 marks (5s.) per half-year. Instruction is given on two evenings a week between 5 and 7 in the following subjects:—

(1) Geometrical professional drawing (glazing models, cutting out from designs).
(2) Lead glazing work.
(3) Making of picture frames, picture framing, etc.

31.

31. *School of the Chimney Sweeps' Guild.*—This school is also maintained by the State, the City, and the Guild.

Each journeyman pays 4 marks (4s.) per semester. Apprentices are admitted free, with the exception of those from another district; these pay 4 marks (4s.) per semester.

There are three classes—one for journeymen and two for apprentices. The subjects of instruction in the first are:—German, arithmetic, drawing, and professional knowledge. These are taught on Sunday mornings, from 9 to 1.

In the classes for apprentices the subjects taught are:—Drawing, German, arithmetic, and professional knowledge.

32. *School of the Wheelwright and Wheelmakers' Guild* is maintained by the State, the City, and the Guild.

The instruction is free for apprentices; journeymen pay for the drawing courses, 2 marks (2s.) per half-year, and six marks for the workshop instruction.

There are three classes for professional drawing and arithmetic, which meet on Wednesday evening from 5 to 9. Workshop instruction is given on Sunday morning, and also on two evenings a week.

33. *School of the Basket-makers' Guild.*—This is maintained by the States, the City, and the Guild. Apprentices are admitted free; journeymen pay 4 marks (4s.) per half-year.

The subjects of instruction are:—

(1) The principles of basket-making and beating work; (2) Small furniture work; (3) Large furniture work; (4) Fine and fancy work.

Instruction in drawing, two hours a week, evening. Continuation instruction, one hour a week, evening.

34. *School of the Berlin Book-binders' Guild*:—Maintained by the City and the Union.

School Fees.—Apprentices of the Masters' Union are admitted free; other apprentices pay 9 marks (9s.), and journeymen 12 marks (12s.) half-yearly.

The subjects of instruction are:—

(1) General book-binding—4 hours a week, evening.
(2) Gilt-edging—2 hours a week, evening
(3) Marbling and account-book manufacture—2 hours a week, evening.
(4) Fine book-binding—3 hours per week, Sunday morning.
(5) Press gilding—2 hours per week, evening.
(6) Hand gilding—3 hours per week, Sunday morning.

35. *School of Gardeners.*—This school is maintained by the State and the Corporation for the Advancement of Horticulture in the Prussian States. The school fees are 3 marks (3s.) per half-year.

The greater part of the instruction is given principally in the winter months, but instruction in land-surveying is given in the summer.

The subjects of instruction are:—

German—2 hours per week, evening.
Arithmetic—2 " " " "
Drawing (two courses)—3 hours to each course, on Sunday mornings.
Book-keeping—2 hours per week, evening.
Botany—1 hour per week, evening.
Fruit and Vegetable Cultivation—2 hours per week, evening.
Soils and Theory of Manuring—1 hour per week, evening.
Plant Culture—2 hours per week, evening.

36. *School for Book Publishers' Apprentices.*—Maintained by the Berlin Guild of Printing-house Proprietors, with contributions from the Magistrates.

The School comprises three classes, the 1st class is divided into six, the 2nd into seven, and the 3rd into eight parallel divisions.

Compositors and Printers are instructed in separate classes.

School Fees.—The pupils of the members of the above Guild pay 3 marks (3s.); all others pay 4·50 marks (4s. 6d.) quarterly.

The instruction is given on Tuesday and Friday evenings from 7 to 9.

The subjects taught in the Class for Compositors are:—German, Latin, French, English, Greek, Arithmetic, Professional Theory, Drawing.

In the Class for Printers, the subjects are:—German, Arithmetic, Physics, Mechanical Drawing, Professional Theory.

37. *School for Tailors.*—The Tailors' Guild pays for each pupil 1 mark (1s.) per quarter. The instruction is given from 4 to 8 p.m. on Monday. It consists of instruction in the cutting-out and making-up of the various articles of clothing, pressing, etc., in the designing of individual articles, clothing in the prevailing fashions, the form of the body. There is also instruction in letter-writing, arithmetic, and book-keeping. There are six classes in which these subjects are taught.

38. *School for Confectioners.*—This is maintained by the Guild of the Proprietor Confectioners of Berlin. Apprentices pay 4 marks and journeymen 6 marks (6s.) quarterly. Four hours a week (evenings) are devoted to instruction in the following subjects:—(1) Garnishing of cakes; (2) Latin and Gothic script with sugar-glazing, iceing; (3) Adorning with figures; (4) Flowers, decorating with, and the painting of figures and flowers; (5) Modelling of subjects of every description in "marzipan" (sugar); (6) Theoretical instruction with reference to the art of baking, the preserving of fruit, the management of a business, etc.

39. *School of the Potters' Guild.*—This is maintained by the City and the Potters' Guild. The instruction is in drawing from wood and plaster of Paris models and professional drawing in pottery and furnace-setting. It is given on Monday and Thursday from 6 to 8 p.m.—during the winter semesters only.

40. *School for Photographers.*—This is maintained by the City and the Photographers' Guild, Berlin. The subjects of instruction are:—

Positive retouching—2 hours per week (evenings).
Negative ,, ,, ,, ,,
Drawing on photographic foundations and freehand from the living model—2 hours per week (evenings).
Drawing from plaster of Paris casts—2 hours per week (evenings).
Experimental chemistry—2 hours per week.
Photographic optics, ,, ,,
Water-colouring and tinting photographs—Sunday morning, from 9 till 1.

41. *School for Tinsmiths.*—This school is maintained by the City and the Tinsmiths' Guild. The subjects taught are:—Professional drawing and arithmetic, geometry, and construction; the artistic side is attended to.

42. *School of the Coopers' Guild.*—This school is maintained by the Coopers' Guild. The subjects of instruction are:—Practical work, handling of implements, etc., theory, computation of volumes, measurements, Sunday, from 10 till 12 a.m.

43 *Conclusion.*—The preceding indication of the various forms of lower technical education provided in the City of Berlin is necessarily very brief, but is perhaps sufficient to shew how extensive the provision is. The general aim is to afford that industrial trade or technical education which shall meet the needs of every class in the community, and the existence of these trade-schools discloses that, according to German opinion, the opportunity afforded by apprenticeship is quite inadequate. In many towns throughout Germany attendance at some form of continuation school is compulsory at the conclusion of the primary school and up to the age of 18, unless a day-school is being attended during the corresponding period.

It is now widely recognised by educationists that German technical education is both thorough and excellent. There is no tendency in Germany to revert to the incompetent method of training through apprenticeship. In fact, apprenticeship is either wholly or partially displaced by the newer systematic instruction, and with enormous advantage, not only to the pupil, but to the community generally. It is true that apprenticeship has not wholly disappeared, but it is no longer in all cases the sole opportunity to become a craftsman; and it is at least widely recognised that for the apprentice to have a reasonable chance of success, he must have other instruction than that obtained in the workshop, factory, or building site.

Much, of course, depends upon the character of persons employed as teachers in the technical schools. When they are both good workmen, and are capable instructors, and when they have an intelligent outlook upon the place of their trade in the distribution of human effort, it is obvious that their pupils will readily reach a degree of expertness and a wider view than was possible under the old system which is now displaced.

CHAPTER VII.

Industrial Education—Trade Schools of Germany.

[J. W. TURNER.]

Introduction.—The scope of Technical Education in the primary school systems investigated by the Commissioners is set out in Chapters XVIII, XIX, XX, XXI of the Interim Report, and, briefly summed up, consists of Drawing, Modelling, Needlework, and Cookery in Girls' Schools; and Drawing, Modelling, Cardboard-work, Work in Wood and Metal, in Boys' Schools. The schools which make this form of teaching a systematic part of their courses of instruction, from the Kindergarten gifts and occupations upward, are those of France, Holland, Norway, Sweden, the Board Schools of England, Scotland, Ireland, the Grammar Schools of the United States, and the Public Schools of Canada. In all these schools the great objective in the teaching is educational, the training of the mind through the hand and eye. As many of the large towns in the countries above-mentioned are busy centres of industry, and as many of the children will of necessity follow in the trade of their parents, the training of the hand and eye is an indispensable part of the regular instruction. The manual training courses of the Elementary Schools, which have for their object the education of the pupil, not the production of artisans, may be considered the foundation of all technical education.

In the Volks-schule of Germany manual training for girls is compulsory throughout the whole course, from the seventh to the fifteenth year. The subjects of instruction are sewing, knitting, mending, darning, embroidery, and making shirts, clothes, &c., housekeeping, and, occasionally, cooking. The teacher need not necessarily be on the regular staff of the school, but she must have passed a regular examination. Manual training is not compulsory for boys, and in very few parts of Germany has it been adopted. Where it has been introduced, the work is most elementary in character, usually consisting of wood-carving, or working in cardboard, and having no reference to any specialisation in trade. In the city of Berlin and its suburbs, in several volks-schulen visited, no manual training in wood or iron, or any other form excepting drawing and needlework, is carried on. Inquiry as to where the schoolboys had opportunities for acquiring this kind of instruction elicited the statement from the head-masters that it could be obtained privately in the afternoon outside the school. The daily course of instruction in the schools referred to commenced at 8 in the morning, and ended at 1 o'clock p.m. The pupils had the rest of the day to themselves, and their attendance at a place for manual training was purely voluntary on the part of the parents. From what could be gathered from the teachers of the masses, it would appear that in the Elementary School no great importance is placed on the subject from a pedagogical standpoint.

But if the subject gets but little attention during the period of attendance in the Elementary School, the German pupil has ample opportunity immediately he passes out of the school to acquire technical knowledge in almost any branch he may choose in the Fortbildungs-schulen.

FORTBILDUNGS-SCHULEN.

These schools are found in every town and city, and in some parts of Germany attendance is compulsory for apprentices up to the age of 18 years. They are continuation schools following on the ordinary public school course with elementary education added where necessary. The programme of the Fortbildungs-schulen includes Drawing and Modelling, Book-keeping and Elementary Commercial Science, Arithmetic and Mensuration, Elementary Economics, Physics, Chemistry, Physiology and Hygiene, German Language and Composition. While Drawing—freehand and mechanical—and Modelling are regular subjects of instruction both in these schools and also in the different grades of High Schools, Manual Training in wood and iron is rarely seen. The teachers of the Fortbildungs-schulen are generally the regular public school teachers, but the teacher of Drawing and Modelling is a qualified person from the Polytechnicum or Academy of Fine Arts.

"TIMES" REVIEW OF INDUSTRIAL EDUCATION IN GERMANY.

The London *Times* of December 4th, 1903, in its fifteenth article on "Industrial Conditions in Germany," gives the following fine account of Education in Germany. The whole article is so apposite to the question under consideration that the Commissioner has no hesitation in quoting it in full:—

"The distinctive qualities of a nation are revealed in nothing more clearly than in its educational institutions. Germany is proud of hers, and the world admits her right to be proud of them. They are regarded with universal respect, and nowhere, perhaps, more than in England. Yet, if one may judge from public utterances, many of those who extol German education have a very vague, if not entirely erroneous,

erroneous, notion of what constitutes its excellence. Otherwise we should hardly have the curious suggestions which are constantly made for improving our own education, or the exhortations to copy the American example; for in this, as in other things, the United States and Germany are at opposite poles. To sprinkle "technical" schools, colleges, and universities about the country, as from a pepper-box, with the aid of millionaires, to modernise the old public schools and universities by substituting science or commerce for classical studies, to secularise elementary schools, and to place within the reach of everybody the same general education up to 18 or 21—these are, roughly, the suggestions most frequently made. There seems to be a general assumption that the more educational establishments we have, the more "technical" they are, and the longer young people are kept in them the better. Those are the principles which have directed educational "progress" in this country and in the United States, but they are not the principles taught by the example of Germany. In this, as in other matters discussed in these articles, the distinctive excellence of German procedure lies in the conscious adaptation of means to a definite end. That is why the Germans are so methodical. They do not act at random, because they keep the end in view. They rarely mistake the means for the end, or become the slaves of words. The reason is, I suppose, that they think things out more thoroughly than other nations. It has its drawbacks; it makes them slow and deliberate. But it makes them sure, and it is the lesson above all others that we need to learn from them, because our weakness lies in the opposite direction. When we clearly see the end we pursue it as directly as any other people, and with unequalled resolution. But we are generally vague and uncertain; we mistake the means for the end, and are perpetually enslaved by phrases. The example of the United States is the worst for us to follow, because there they are also vague, though not so vague—rather more phrase-ridden, and wildly adventurous into the bargain.

"Now, education in Germany is regarded and treated as the means to an end. The end is the production of good citizens and the promotion of national strength and efficiency. I suppose that would be generally allowed to be the end here; but the difference is that in Germany it is kept in view, and here it is not. All kinds of things are substituted. First, education is made an end in itself; then, schooling is confounded with education, and its multiplication and prolongation become ends; then, some "system" or "method" is exalted into a fetish; the word "science" or "technical" dominates some minds; in others, religious animosities, or party politics, or social ambition, or class feeling are the actual motives. Amid all these things the real end drops out of sight. An illustration may be taken from the most justifiable of these aberrations—the cry for technical education. It takes the form of demanding institutions like those of Germany or some other country, and multiplying them in a promiscuous fashion. The end is never clearly formulated, but technical schools become an end in themselves. If we really took Germany for an example, we should first ask ourselves, "Whom are we going to educate, and why?" and we should adapt the means accordingly. We have a large number of technical schools; but if you inquire of those interested in them what they are aiming at, you find at once the most vague, confused, and contradictory ideas prevailing. Some think their object is to produce better workmen, others that it is to produce anything but workmen. To reconcile the various objects intended to be served by the same institutions, you must have recourse to the most general formula, and say that their purpose is to teach something useful to anybody who cares to learn. I dwell on this confusion, not in comdemnation of our schools, which have many good points, but in order to make clear by contrast the distinctive qualities of German education. It is not so much the institutions that we should take for our example as the spirit and purpose which have fashioned them. From top to bottom they have been developed out of the past, by a logical process, to meet clearly-defined needs arising out of the march of events. They have thus become differentiated into many grades, each adapted to a specific purpose. To give even the briefest account of them all would occupy a great deal of space, and would be quite beyond the scope of these articles. It will be sufficient to take the chief points bearing on industrial efficiency.

"*Elementary Schools.*

"Elementary education is compulsory throughout Germany from 6 years up to an indeterminate age, which is in practice usually 14. Individual school liability may cease before that age, at the discretion of the district or local inspector, if the child has reached the standard deemed sufficient. All children are required to have this schooling; and if they do not receive it elsewhere, to the satisfaction of the State, they must go to the public elementary schools. About 95 per cent. of the children of school age are taught in these schools; that is to say, the great mass of the people receive their elementary education there. It is free in some parts of Germany, but not in all. Of the two States with which we are chiefly concerned, Prussia has free elementary education. Saxony has not. There the parents pay a small fee—usually 5s. or 6s. a year—but if they are totally unable to pay it may be remitted. In both States, and, I believe, throughout Germany, they have to provide the books and other things required.

"The function of the Volks-schule, or people's elementary school, is "the religious, moral, and patriotic training of the young by education and teaching, and their instruction in the general knowledge and acquirements requisite for civil life." This definition gives the key to the whole educational scheme. Character and conduct are the primary objects, then love of country, then such general knowledge as will enable the child to take its part in the ordered life of the community, whether as man or woman; and, after that, the special knowledge. Religion, therefore, comes first, as the indispensable foundation of morality and conduct. The logical German mind holds that morality cannot be efficiently taught apart from religion, and further that religious teaching, to be effective, must be dogmatic. For this the law carefully provides. The schools are denominational and separate for Roman Catholics and Evangelicals, except where there are not enough children of one confession to form a separate school; in that case they are mixed—*paritätische* or *simultanschulen*—but the children receive religious instruction from teachers of their own confession. In 1896 there were in Prussia 680 such schools, principally in Posen and West Prussia; in a few towns all the schools are mixed. In many towns there are also separate Jewish schools, and occasionally one or two of some other sect. In all cases they are on a footing of equality before the State and the law, which ordains religious teaching, but leaves the choice free. The instruction is divided into (1) Biblical history, (2) catechism; the latter, of course, is dogmatic. Each has so many hours a week given to it; as a rule, three to Biblical history, and two to catechism. In Evangelical schools both are taught by the teachers; in Catholic schools Biblical history is taught by the teachers and catechism by the clergy. I dwell on these details, partly because they are not known in England, and partly because of their significance in the educational scheme, which can, I think, hardly be over-rated. Just as the Germans have known how to retain the classical element in their higher education while adding

adding the highest developments of science and other modern studies, so have they known how to build up the most complete system of national education upon the old foundations of character and conduct. They have not flung away the old in acquiring the new, but have combined them. The retention of systematic religious teaching has a far-reaching influence on the national life, which is plainly visible in many directions, and not least in the industrial sphere. To it may be traced the sense of duty and responsibility, the respect for law, the steady effort, the self-restraint, the maintenance of a higher ideal than the materialism of social democracy, which have been noted in previous articles. And to these may be added the striking absence of corruption in public life, which is the indispensable condition for the healthy exercise of those municipal functions that are carried on upon so large a scale in German towns to the benefit of the community.

"The other subjects of instruction are the German language, arithmetic, with elements of geometry, drawing, history, geography, natural history, and singing; also gymnastics and drill for boys and domestic hand-work for girls. Great attention is paid to the language. The children are taught to speak, read, and write correctly; and particular pains are devoted to secure clear enunciation and good pronunciation. Thoroughness is the great aim, quality, not quantity of accomplishment. The standard of handwriting attained is remarkable. Altogether the scheme of instruction carefully avoids the ambitious and fanciful; it aims at the thorough mastery of elements rather than a smattering of extras, and as there is no competition for grants the children need not be crammed.

"The school year begins at Easter, and varies from forty to forty-six weeks. The holidays, which occur at Midsummer, Michaelmas, Christmas, Easter, and Whitsuntide, take up eight weeks in the country and nine in the larger towns. They are somewhat longer in Southern than in Northern Germany. The school week ranges from 20 hours in the lowest classes to 32 in the highest. Attendance is remarkably regular and punctual. In the upper classes boys and girls are separated as far as possible; co-education does not find favour in Germany. Corporal punishment is allowed, but teachers are directed to administer it as sparingly as possible. The law runs as follows:—

"Only after repeated and unsuccessful application of one of the former punishments (reprimand, standing-out, detention after school, etc.), or on account of flagrant disobedience or gross misconduct, is a moderate corporal chastisement permitted, but always in a measured form, and so as not to be injurious to health. The corporal punishment of girls is to be avoided to the utmost.

"The school buildings are regulated by law with respect to height of rooms, cubic space, and other matters. Great attention is paid to ventilation, warming, and light, and in these respects the newer schools, in towns at least, are excellent. I have previously noted the value attached to good lighting in factories; it is the same in the schools. The Germans appear to me to have realised more than most people the very simple facts that a bad light spoils the eyesight by straining accommodation, and that a good one greatly increases efficiency by diminishing the expenditure of nerve energy on mere perception and consequently releasing it for other work. So far as one can make a general statement from a limited field of observation I should say the school buildings are plain and unpretending but adequate and well adapted to their purpose.

"The most important factor, however is the teaching staff, and this is, I think, the strongest point in the German system. The teachers are trained in seminaries, of which there were in Prussia 129—120 for men and nine for women—in 1901. The course there lasts three years, and is carried out in three classes, but the training really extends over six years, as the seminary is preceded by three years in preparatory institutes, which are maintained either by the State or by municipalities. In Saxony the whole six years are passed in State training colleges. Qualification for appointments is obtained by examination at the close. In addition to the systematic preparation for the career thus secured, the efficiency of the teachers is promoted by their recognised position. They have the duties and rights of civil servants, and as such enjoy various privileges, including partial exemption from liability to military service and from municipal taxes, as well as an assured and sufficient income and a pension. The official position has, further, a moral value in Germany which it lacks with us. It carries with it a dignity and respect which in an educated man generate self-respect and self-confidence, the opposite of self-assertion. The German elementary school teacher has no need of self-assertion and consequently does not teach it—that bane of our elementary schools. He is somebody, has a definite social standing, though it may be humble, and takes a pride in his work. These moral factors count for more than syllabuses or examinations. The impression gained from observing class-work in operation—it cannot be more than an impression—is that the teachers are extremely well qualified for their work and take great pains with it. I am pretty certain that German children are of slow rather than quick intelligence; time and patience are required to ground them thoroughly, and these are given. The proportion of conscripts unable to read and write is constantly diminishing. In 1900 it was only ·1 per cent. in Prussia. A weak point is the size of the classes. The limit for single-class schools is 80, but this is sometimes exceeded. For other schools it is 70, or in some places 60. On the other hand each class has a room to itself. In the towns the schools have mostly six or seven classes, and the average number of children in a class is about 40 or 50. I have not observed a large proportion of spectacled children. The proportion of female teachers is very small on the whole, but it varies greatly in different places. For instance, Düsseldorf had (1901) 257 men and 227 women, Chemnitz 523 men and 15 women teachers.

"The cost of elementary schools is chiefly borne by the local community out of the taxes, with subsidies from the State. This entitles the community to a share in the administration, which is, however, mainly in the hands of the Government. The organisation varies in different parts of the country, and is somewhat complicated. It will suffice to say that the most important factor is the district inspector, who is a Government official. He wields authority over the internal management of the school, the teaching, discipline, and so on. In Prussia he is under the school department or council of the provincial Government; in Saxony, immediately under the Ministry of Education. The buildings and external matters fall within the jurisdiction of another Government official. Under the district inspector is a local inspector to each school; he is generally the parish clergyman, particularly in evangelical districts, and acts as chairman of the school committee, which represents the local community. In towns the latter is generally the municipality, but the school community is not necessarily identical with the municipal. The actual share taken in the administration by the local authority, representing the ratepayers, varies considerably and can hardly be defined. In practice it amounts to a good deal, at least in towns.

"It must be understood that in dealing with this very large subject I have only touched on the main features of elementary education as bearing upon industrial life. For further details the reader is referred to the excellent essays published by our Education Department, and particularly those in Vol. 9 of the Special Reports. I have read these essays since making a study on the spot, and have been much fortified in a laborious inquiry to find both facts and impressions confirmed by observers of much greater experience in elementary education than my own.

"A few statistics may conclude this branch of the subject:—

"German Empire, 1901.

Volks-schulen.	Male Teachers.	Female Teachers.	Scholars.	Total Cost.	State Contributions.	Number of Scholars to Each Teacher.	Average Cost per Child.
58,164	122,145	22,339	8,829,812	£20,614,300	£6,017,800	61	£2 7s.

"*Continuation Schools.*

"At 14 the children leave the elementary school after eight years' schooling, divided into three grades, and begin to earn their living. Some indeed do that earlier. I have already mentioned that in 1901 there were 9,454 children under 14 employed in "Fabriken"; and a very large number, sometimes at quite an early age, are further employed at home or in business other than Fabriken. A new law has just been passed regulating both these classes of employment. Broadly, however, the normal course is for boys and girls to go to school till 14 and then to work either at home, helping their parents, or in business. In trades where apprenticeship obtains boys are apprenticed; in others, boys and girls are taken on at a low wage—say, 2s. 6d. a week—and work their way up as they grow and acquire the skill. They learn their trade in the place where it is carried on, which is the only place where it is or can be properly learnt. But in order to prevent their forgetting all they have learned in school, which they readily do, and to promote their mental development in the same direction, continuation schools have been established, where they get a few hours' instruction in the week from 14 to 16, 17, or 18 years of age. There is no uniformity about these schools, which have been developed out of voluntary efforts; they are different in towns and on the land, different for boys and girls, and different again in different States, being compulsory in some and not in others. I confine myself to those bearing upon industrial life. In Saxony and some other States continuation schools are compulsory throughout the State for boys from 14 to 17; in Prussia they are optional; that is to say, local authorities have power to establish them and make them compulsory. The use of this power is gradually extending; at present the schools are most developed in Nassau. The boys attending them are mostly learning or exercising a trade; whether a handicraft or work in shops or factories. The object kept in view in the schools is twofold—(1) to continue their general mental development, (2) to help them to become efficient in their trade.

"As Düsseldorf is one of the latest towns to adopt these schools, it may be taken to illustrate their aims and character according to the most recent ideas. The by-law establishing the schools and authorised on December 10th, 1901, provides that all apprentices and youthful workers engaged in every sort of trade, including commercial business, in the town are bound to attend the continuation classes on the days and hours appointed until the end of the school half-year in which they complete their 16th year. If they fail to reach the standard required, the liability may be prolonged for another half or full year. Only those are exempted who can produce evidence to the satisfaction of the school committee that they possess the knowledge and acquirements which it is the aim of the school to impart. Youthful workers, apprentices, etc., who have passed the school age may be admitted as voluntary pupils on payment of the school fee, with the consent of the Committee. Employers are bound to contribute 1s. 6d. quarterly for each scholar employed by them of school age; voluntary scholars pay the same. Scholars are bound to attend regularly and keep the rules, under a penalty of 20s., or three days' imprisonment. The latter has been applied in two or three cases. Parents and guardians are bound not to keep boys from coming, and employers are bound to let them leave off work in good time to attend school; both under the same penalty as above.

"There are, therefore, both compulsory and voluntary classes, and to these must be added a third branch—namely, drawing classes for boys, which are also voluntary. The number of pupils on the register for the winter half of 1902 was—compulsory, 1,612; voluntary, 1,026; boys' drawing 224—total, 2,862. The compulsory classes are the most important. In their arrangement the calling of the pupils is the guiding principle. The classes number 49, thus distributed:—Preparatory for backward lads, 2; unskilled workers, 13; metal workers, 12; shop apprentices and clerks, 6; building trades, 4; art trades, 3; bakers, 2; graphic trades, 2; barbers, butchers, gardeners, saddlers, shoemakers, plasterers, 1 each. The size of the classes varies from 18 to 45. They are held in the elementary schools. The hours are in all cases six a week—namely from 5 to 8 p.m. twice a week, except for the barbers and bakers, whose hours are 2 to 5 p.m. No compulsory classes are held on Saturday. The voluntary classes are held on Sunday morning, 9·30 to 12·30, or in the evening, 7 to 9, on one or two days in the week. The subjects of instruction are drawing, arithmetic, reading, composition, book-keeping, knowledge of social legislation, and other matters bearing on the rights and duties of the lads as members of the community. For instance, they are instructed in the labour laws, the legal relations of employers and employed, workmen's insurance, the object of tariffs, taxation, and similar matters. Arithmetic and reading are carried beyond the Volks-schule limit, and essays are set in such subjects as those mentioned. But the chief energy of the Fortbildungs-schule is expended on drawing, which is taught in the most methodical manner and on a carefully devised system. The principle is, while training the hand and eye, to make the exercise bear specifically upon the trade in which the pupil is engaged; and great ingenuity is expended on adapting the lessons accordingly. The lads have to come clean, and particularly with clean hands, which has a good disciplinary effect. Dr. Kuypers, the Government District Inspector, who has been placed in charge of the Düsseldorf Fortbildungs-schule and is responsible for the organisation, has studied the English voluntary continuation schools and formed a high opinion of them, especially those in London. He has utilised various suggestions picked up there in the organisation of his own. In Germany, I may say generally, they are very well informed about English institutions and frankly appreciative of their merits.

"The

"The German continuation schools are for the most part administered and maintained by the municipality, under Government supervision, and with the aid of a grant. They also receive in in many cases substantial support from employers, who have also founded and maintained such schools, where they did not otherwise exist, on their own initiative. Other employers, again, where there are none, insist that their apprentices shall attend neighbouring schools. A special class of continuation schools called "work-schools" is maintained in the State mining district of the Saar, and the miners of the Ruhr coal-fields have a number of their own.

"*Domestic Schools.*

"In the Volks-schulen, girls are taught sewing and other hand-work up to 14. Afterwards, those who stop at home and help their mothers have an opportunity of learning and practising all kinds of housework; but in an industrial country, such as Germany has become, a great many begin to earn their living at once in factories and shops. They are apt to forget what little they have learnt and to acquire no further domestic accomplishments until they marry and enter the school of experience unprepared. This defect is to some slight extent, but in no uniform manner, remedied by domestic schools, of which there were in the year 1897, 163 with 9,689 scholars. Only 12 of them were established by municipal or other local authorities; the great majority are carried on by religious bodies or by employers of labour. A few are of ancient foundation, but, as a whole, these schools are the creation of the last few years, and may be regarded as a beginning. The subjects of study are cooking, sewing, knitting, ironing, and other household occupations. In these respects, the education of girls belonging to the middle and upper classes is far better provided for than that of the lower classes, although the latter have more need of it.

"*Trade Schools.*

"The education hitherto described is of a general character, with at most an indirect bearing on particular callings. If I am not mistaken there is a general impression in England that Germany possesses a very superior educational system for the training of workmen in their particular trades, to which the industrial progress of the country is largely due; but that is not so. They learn their trade in the workshop, just as our own workmen did in the days when they were more capable mechanics and artisans, if old hands are to be trusted, than they are now. Apprenticeship is still the technical school for workmen to-day in Germany; very few indeed, if foremen are excluded, attend the schools which are called technical in England. There are, however, some trade schools and workshops in which opportunity is given to lads of that class to study their calling more fully and to acquire greater proficiency than is possible in the regular course of ordinary work. Some of them are established by associations of employers, such as the metal industries of the Berg district, which have a school at Remscheid, or by individual firms. Guilds (Innungen) have the power to establish schools for their own trades, which are the handicrafts. They also assist in the classes of the Fortbildungs-schule for their own speciality. No comprehensive information is to be obtained about trade schools of this class, but they are particularly numerous and well organised in Berlin. Practical and other instruction in the more artistic crafts is given at art-trade schools, such as that at Düsseldorf, which has been already mentioned in the account of that town. On the whole, it must be said that the technical schooling of ordinary workmen plays a very small part in the industrial development of Germany.

"*Military Service.*

"There remains one truly educational factor in the life of the workman, though it is not usually regarded in that light. At 20 all male German subjects, with some trifling exceptions, are liable to service with the colours for two years in the infantry or three years in the cavalry. It is reduced to one year in the case of elementary school teachers and candidates for the post, and to one year's voluntary service for those who have reached a certain standard of higher education, or who pass the required examination. Practically, the male population passes through the ranks at the age 20-22. The liability comes just when a lad has learnt his trade and, undoubtedly, forms a break in his civil career; but I have met with no two opinions about its educational value to the individual and its industrial value to the nation. Perhaps the most striking effect is the physical benefit derived from the exercises, drill, gymnastics, and regular life. It turns a weedy anæmic lad into a well-knit upstanding young man with sound lungs and well-developed limbs. It further teaches him cleanliness, discipline, order, authority, self-respect, and respect for others. The effect in the workshop is visible at every turn. It is hardly too much to say that military service is, more than any other educational influence, the making of industrial Germany. Employers and employed have gone through it together; they have learnt in the same school, and they equally understand that order is essential to every organised force, industrial as well as military. It is sometimes objected that military training has the defect of making men automata and incapable of initiative. That is certainly possible. Nor can it be denied that the Germans, and particularly German workmen, are weak in initiative; but that appears to me to be in the national character, which is essentially deliberative rather than adventurous. Their virtue is order, and they do well to cultivate it. Perhaps, if the sole object of the training were social or industrial, it might be somewhat relaxed with advantage; but, as things stand, no unprejudiced observer can fail to see how great a source of physical and industrial strength it is."

The syllabus of one Continuation School is given, and that in the City of Dresden has been selected.

CURRICULUM OF THE MUNICIPAL CONTINUATION SCHOOL, DRESDEN (1898).

I. The purpose of the Continuation School is to further the *general* education of its pupils, and to give them such knowledge and experience as they need in their further private life, and especially in their trade.

Therefore, the subjects, and of course, tuition, must be adapted to *local* conditions and requirements; but at the same time the right proportion between general and special trade instruction must not be neglected.

It must always be remembered that the teacher cannot do any better for a youth than to, at the right time, and under a proper system, introduce him to the purpose of his life.

A youth's interest in the subjects of tuition may always be kept up by constantly relating to his private and professional work.

The

The local Continuation Schools though they are, in fact, professional schools, are, at the same time, educational, and it is their constant aim to make their young people moral and religious.

The Continuation Schools have a three *years'* course, four hours weekly.

Each school is divided into a branch, *with Drawing* (Branch A), and one *without Drawing* (Branch B).

Within these *main* branches the pupils are to be distributed according to their trade, their former education, and their intellectual capacity, into one of these three classes, viz., 3, 2, and 1. (3 is the lowest, 1 the highest class).

Those pupils that have just left the public school (volks-schule), at 14 years of age, will usually be put into the third (lowest) class;—especially well prepared pupils may be put into a higher class, according to the results of an examination at the beginning of the course.

Pupils entering during the course of the year will be classified according to their last school certificate.

If, during the year, it should be found a pupil is put into a class too high or too low, he may be transferred.

Alongside these three classes, a fourth one has been introduced for pupils that have not fully reached the aim of the public school. In this class these pupils are to be prepared for entering 3rd class in the following year.

The lessons consist of *German, Book-keeping, and Business Knowledge, Caligraphy, Shorthand Writing, Arithmetic* with *Geometry; Realistics,* such as Geography, History, Natural Sciences, Law Knowledge, Political Economy, and *Drawing.*

In the drawing classes, which chiefly consist of *trade* apprentices, Drawing takes the place of Caligraphy, with two-hour lessons per week, and at the same time, Arithmetic, Geometry, and Realistics are shortened.

Commercial apprentices, office boys, &c., receive in the second and third year lessons in Shorthand instead of Caligraphy.

All lessons are to be co-ordinated.

Lessons have to start where the public school course terminated, and their purpose is to consolidate such instruction and show its uses for practical life.

Lessons have to start and close punctually with a prayer spoken by the teacher, or, if practical, with a song.

II. The various subjects of instruction:—

1. *German.*

The education in the German tongue has to be well cultivated in *all* lessons.

The instruction in German consists of Reading and Composition; where necessary, Grammar and Spelling form part of the teaching.

In all written work, pupils are to be made to write cleanly, clearly, and smartly.

A.—Reading:

Only in the fourth (preparatory) class, as an independent subject.

In the higher classes the reading matter is to impart useful knowledge, create opinions, encourage independent reading; to be selected alternately from idealistic and realistic matter.

Explanations must *not* particularise too much; must show only the main contents, etc., and must bear on the pupil's aims in life.

B.—Composition.

By composition pupils are to be taught to write down their thoughts correctly, and in proper order, and especially to write out simple business-letters and documents as wanted in everyday life.

All business compositions have to be previously explained with the forms and terms now used, and have to be then worked out by the pupils with reference to their trade.

The sequence of these business-letters has to be maintained, so as to form a complete business transaction right through.

Class 4—

Copies and dictation; simple exercises in connection with reading-matter, short business communications and advices, invoices, receipts, etc.

Class 3—

Fuller communications *re* purchase, sale, rent, order of goods, despatch of goods, with invoice-letter and advice note; delivery-order receipt, payment by cheque, money-order, &c. Advertisement: journeyman wanted; letter of application, etc.

Class 2—

Circular advertisement: business apprentice or journeyman wanted. Contract with apprentice. Reference for employer. Letter reminding client of payment due but not paid. Request for renewal Promissory-note. Security. New year's and other congratulations to friends and relations. Letters to authorities.

Class 1—

Subjects arising from the course of Book-keeping: circulars, announcements of business opened or transferred, tenders for contracts, calculation of costs, power of attorney, agreements, bills of exchange, bills of lading, forms for despatch of goods to foreign countries, etc.

C.—Book-keeping and business knowledge.

Pupils are instructed in Book-keeping and business knowledge as far as they can possibly understand.

Matter and course of instruction are to be adapted to the profession of the bulk of the pupils.

Business events connected with their profession have to be introduced to serve as starting-points for instruction in business knowledge, production of raw materials, tools, machines, business institutions. This matter is to be treated too in connection with the Arithmetic lessons.

Practise single entry system. Enter a two-monthly business course in the necessary books, and do all the written work in connection with the business events.

Drawing classes do only a *one*-monthly course.

Books

Books to be kept—Stock Book, Journal, Cash Book, Ledger. As secondary books—Wages and Calculations Book.

All business events are first to be entered in a Journal from which they are transferred to the Ledger and Cash Book.

Take stock and make a balance to show profit or loss.

Pupils attending 1st (highest) class for a second year to be taught to work independently.

D.—Caligraphy and Shorthand Writing (in branch B).

2. *Arithmetic and Geometry.*

By the arithmetic exercises pupils are to learn to quickly, correctly, and independently make all calculations for practical life.

Every lesson is to start with short exercises of mental calculations.

Only exercises useful for practical life. The profession of the pupils is always taken into consideration, and too complicated examples are avoided. Special practice is given in *German* coin, measurement, and weight system.

Class 4—

Repetition of the four fundamental methods of calculation—decimals, measurements, weights, and money calculation.

Class 3—

Repetition of the four fundamental methods of calculation—decimals, measurements, weights, and money calculation. Price calculations, calculations of interest.

Class 2—

The four fundamental kinds of calculations with ordinary fractions. Rule of three with fractions. Interest, discount. Alligation calculations. Examples from sick fund and accident fund; subscription calculations.

Class 1—

Repetition of all kinds of calculations in connection with book-keeping—Commercial calculation, daily interest, profits and loss, calculations of costs, stock, shares; compound interest, old-age pension, and invalid pension calculations.

Geometry.

Specially to practice the construction and calculation of spaces, in continuation of the lessons learnt in the Public Schools, with due consideration of the profession of pupils. Geometrical exercises may be combined with Arithmetic lessons, and in case the whole of the teaching is done by one teacher, Geometrical exercises may be treated with Drawing lessons.

Class 3—

Repetition of the various kinds of lines and angles, calculation of straight lined planes, the regular quadrangles, triangles, irregular quadrangles, cubes, cubic measurement, simple constructions. (Partition of lines, angles, planes.)

Class 2—

Calculation of bent-lined planes, and simplest bodies. The circle, ellipse, prism, pyramid, cylinder, simple constructions in connection therewith.

Class 1—

Calculations of straight and curved lined planes, the flattened pyramid, the cone, the flattened cone, the sphere, constructions therewith.

Practical examples and uses for all the rules.

3. *Realistics.*

Since time is too limited to treat the Realistic subjects separately, *Geography* is to be made the centre of consideration and all other subjects are to be treated in connection therewith.

The 3rd Class of the B branch has for this subject one hour per week for the whole year, while Classes 2 and 1 take first Geography, and later on No. 2 takes Law teachings, and Class 1 takes Political Economy.

In the A branch Realistics change with Arithmetic and Geometry each week.

Connecting with the aims of the Public School, the pupils are to be made acquainted with the conditions of Nature and the life of their immediate surroundings, in such a way as to improve their mind and character; their interest in public and industrial pursuits, etc.; to encourage them to independently continue their own education.

Patriotism is to be encouraged by all possible means, with due respect to local conditions.

In the natural sciences, teaching of Sanitary rules is to be included; the instruction in Geography and History is to be made the basis for Law teachings and Political Economy.

All uninteresting strings of names of towns, rivers, countries, and figures, etc., are to be avoided.

In the teaching of Law, it is not only necessary that the pupils are made acquainted with the forms of Government, but they must be shown how the welfare of every individual depends on the obedience of *all* citizens to the law, etc.

Class 3—

The kingdom of Saxony, according to situation, size, surface, climate, and population, with consideration of natural and artificial products, commerce, etc.; important means of communication, coal-mining, iron ore (where found and where treated), corn-growing and milling, timbers and their uses, building stones (sandstone, granite, porphyry), chalk and clay.

Useful animals (cloth manufacture, tanneries, glove and boot trade).

Spinning plants—spinning and weaving.

Imports, exports by rail or by water (Elbe).

Germany in much the same way, giving chapters of history in connection with important places.

Remark.—Law and Political Economy are not taught in 3rd Class, because, otherwise, pupils going straight into 2nd Class would lack the basis of this, to them, new matter, while they are supposed to know already the geographical and historical matter taught in 3rd Class.

Class 2—

Class 2—

Geography—

The European countries with their relation to German commerce and trades. 12 hours.

Law—

(*a*) Family: Father's power, will, trustees, servants, apprentices, workmen and their relation to their master.

(*b*) Community: Political, School and Church Communities, their rights and duties Police, Local Government, and Taxes.

(*c*) The State (Saxony): The King and Royal family, the Government, constitution, Ministry and its departments. Loans, State taxes, Courts. The Oath.

(*d*) The Empire: Constitution, Government Consuls. Ambassadors, German Subject. Naturalisation. Invalid and Old-age Pensions. Finances, Army and Navy, Customs, Monopolies, Taxes, Loans.

Class 1—

Geography—

The more important Countries (not European), with their relation to German Commerce and Trade. German Colonies; Mail Steamer lines. 12 hours.

Political economy—

Requirements of the individual and community.

I. Production of Goods—

(*a*) by nature; natural powers used by man to assist him.

(*b*) by work; partition of labour, Trades, Trades Unions, Factories, Wages, Strikes, Parties.

(*c*) by capital, invested and circulating capital. Landholders. Machines, Tools, Companies on Shares, Patents, Trade-marks, Copyright. Capital interest. Credit, Cheques, Bills, Paper-money, State Loans, Bonds, Banks' Exchange, Rates.

II. Circulation of Goods, Barter, Price, Money, Supply and Demand, Competition. Commerce and means of communication (Railway, Post, Telegraph, Telephone). Tariffs.

III. Distribution of Property and Consumption of Goods. Poor and Rich, economy, avarice. extravagance, luxury. Savings Banks, Insurance.

4. *Drawing.*

By the drawing lessons, pupils are to be improved both in their taste for beautiful forms and in their technical skill, and to be taught to use their skill on tasks of their particular trade.

According to their professional requirements, pupils are to be taught either more freehand drawing or more constructive drawing.

Drawing of figures or part of figures, to understand which art study would be necessary, is to be avoided; same with simple copying of drawings.

Pupils to be arranged in groups according to trade as far as possible.

It is the purpose of the 3rd Class to equalise the differences in performances of the pupils by suitable exercises in ornament and line drawing.

To exercise the eye in colouring, fill in with water-colours, and to give special attention to the careful drawing of the outlines as the *most* important part.

In the 2nd Class pupils are to be employed in drawing from professional models or designs, or transferring from such in given scales.

In the 1st Class professional drawing is to be continued, with proper regard to individual abilities or inclinations. Sketchings from objects in certain scales, correctness of which is to be checked by the teacher, and which are to serve as bases for elaborate drawings.

Pupils are to be taught to understand all sorts of drawings used in their trade, to be able to work from them, to trace objects technically correct, and to create simple designs. Mechanical aids are allowed to be used.

Every drawing to be handed in to the teacher fully finished, signed, etc., giving hours of work devoted to it.

(*a*) The freehand drawing is specially for apprentices of the decorative trades, decorative and porcelain painters, lithographers, engravers, sculptors, stucco-workers, barbers and hairdressers.

(*b*) Constructive drawing for lock and black smiths, engineers, bricklayers, carpenters, joiners, stone-masons, etc.

Drawing compasses, squares, etc., to be used.

(*a*) Freehand Drawing.

1. For decorative trades:

Class 3—

Ornaments in preparation of professional drawing coloured.

In summer, class all taught together, and in winter in groups separately.

Class 2—

1. Professional drawings—Transferring of decorative designs in given proportions. Taught in trade groups.

Class 1—

Continuation of professional drawing, etc.; its uses for putting together of new designs, etc.; decorations.

Able pupils to work from nature (perspective, the elementary laws of light, etc.).

2. For barbers and hairdressers:

Instead of caligraphy, these get one hour drawing a week, similar to the decorative trades.

(*b*)

(*b*) Constructive Drawings.—For Locksmiths.

Class 3—

Freehand drawing from models—(Enke's), spiral, etc.; linear drawing, to get pupils used to the handling of the square, drawing-compasses, and curves.

Construction of regular polygons, important as the basis for rosettes, etc.

Projections drawing.—Cube, oblong, round column, six-sided column, cone, screw, profile cuts, various iron shapes, round, square, and flat, T-shape, cross-shape, double T (I), cylindrical (hollow); the simple lock, with screw-holes, etc.; simple iron railings; the standard key.

Class 2—

In Summer—Exercises in professional drawing, of railings, etc., from models and designs. Individual instruction.

In Winter—The chamber-lock, the catch-lock (door-lock), (padlock), the bolt-lock (bolt and bar). Class instruction.

Class 1—

In Summer—Drawings for construction of railways, gates, etc. Sketches according to scale. Individual instruction.

In Winter—Various kinds of complicated locks and keys. Class instruction.

2. For Engineers—(Engine-builders and Machine), more or less the same as for Locksmiths, but with special regard to their trade.
3. For mechanics and electricians, but with special regard to their trade.
4. For building trades—Bricklayers, Carpenters, Stonemasons, and related trades, but with special regard to their trade.

In the highest (1A) *Baker* class, instead of Realistics, the following are taught:—

Business and trade knowledge—

1. Establishing a Bakery—Laws and by-laws relating to it.
2. The Bakery—Dimensions, ventilation, heating, lighting (kerosene, gas, electricity); tools and dishes, the baking-stove (oven), wood and coal burning.
3. The Flour—Milling, quality of flours, mixing, storing, and cleaning of flour.
4. Ingredients—Water, milk, yeast, salt, butter, eggs, sugar, saffron, natron, ammonia, etc.
5. Products—(*a*) Bread, dough, kneading-machine, process of fermentation, proper weight-scales; the baking process; various kinds of bread—their digestibleness and nutritiveness; prices of bread. (*b*) Rolls; dough; parting-machine. (*c*) Fine baking, cakes, double baking, biscuits, wedding-cakes, etc.
6. Development of the Trade—Historical, union, laws, master, apprentice, and journeyman; working-time, wages, insurance, lodges.
7. Corn Trade—Corn exchange; corn usury (corners); railway and river tariffs; corn-producing countries; colonies; mail steamers.
8. Capital, credit, bills, banks, share, trade, and commercial laws.

Working Plan (Hours per Week).

	A (Drawing).				B (*not* Drawing).			
	Class.				Class.			
	4.	3.	2.	1.	4.	3.	2.	1.
Composition, Book-keeping	1	1	1	1	1	1	1	1
Reading	1				1			
Drawing	1	2	2	2	......	......	......	......
Caligraphy, Shorthand	......	......	......	......	1	1	1	1
Arithmetic and Geometry	1	1*	1*	1*	1	1	1	1
Realistics	...				....	1	1	1

* In turn (weekly).

CHAPTER VIII,

CHAPTER VIII.

Continuation, Trade, and Technical Schools of Other German Cities.

[G. H. KNIBBS.]

1. *Introduction.*—Although the educational features of the various Kingdoms and Grand-duchies, etc., of the German Empire are not absolutely identical, forasmuch as they have grown up independently, there is a generic likeness between them. The common language, and the educational earnestness of the German people, leading directly to a healthy spirit of emulation in so important a public institution as the educational system, have necessarily produced the result mentioned.

In the two preceding chapters, the features of lower technical education in Berlin and Dresden have been outlined.

Throughout Germany there are schools designed to supplement the education of the primary school, the school of the masses, the folkschool as it is called. Such schools are more or less technically organised. They serve the double purpose of extending and consolidating the education in the folk-school (Volkschule) and of supplying some degree of practical education touching more directly the necessities of the career in life.

Such schools are typified by the *Fortbildungsanstalten* of various parts of Germany—the institutions in which the education is extended, or continued. They are not intended to lead on to higher schools, and the University, they are practical in their aim, though in a liberal sense.

These institutions may be State institutions (*staatlichen*) or municipal (*städtischen*), and they may have a definite orientation toward industry—*i.e.*, they may be *gewerblichen*. Thus one finds schools with such a title as "*Städtische Gewerbliche Fortbildungsschule*," which may be rendered Municipal continuation industrial school, or again with the title "*Gewerbliche Fachschule*," which may be translated Industrial-craft school.

When the schools deal with those forms of industry which demand considerable artistic knowledge, they are known as "*Kunstgewerblichen Schulen*," *i.e.*, schools for artistic industries.

Sometimes the schools are limited in their sphere of work to a particular trade, craft, or "*Fach*," and are then known by the name of the trade, as "*Steinmetzschule*," a school for teaching the art of the stonemason, or "*Webeschule*," a school for teaching the art of weaving, and so on.

Naturally the localising of certain forms of industry tends to accentuate the frequency of certain types of school, or to call into existence particular schools. It is worthy of special remark, however, that although on the whole schools of a given type will tend to rise in response to a corresponding demand, Germany has not merely shewn that she is willing to act when the demand *has* arisen, she has also shewn a readiness even to *anticipate* the demand.

The natural activity of a people does not, of course, depend wholly on the fact that a particular type of industrial instruction is provided for; but given that a nation is not subjected to artificially created and harassing restrictions in industrial effort, the efficiency of that effort does largely depend upon the thoroughness of the general and technical preparation for it.

Throughout Germany this is recognised, and that young people may enter on the serious work of life in an efficient manner, and at as early an age as possible, the continuation, trade, or lower technical schools have been created.

While it is recognised that in all cases the school and its workshops cannot reproduce the complete conditions of practical work, it is recognised also that it *can* meet almost every demand to equip the workmen thoroughly. In the building trades, for example, it may be true that a youth leaving his technical school will not feel at home on a large building; he will need experience; he has, nevertheless, learnt his craft, and to accustom himself to the conditions of its practical exercise is relatively an easy matter.

2. *The Lower Technical Schools, generally.*—It was obvious to the Commissioners, in reviewing the equipments for technical instruction, that the work was seriously undertaken, though it is, of course, true that equipment does not necessarily represent systematic work. The character of the whole effort, and the personnel of the teaching staffs was, however, sufficient proof of the fact that the inner merit of the system was equal to its outer pretensions.

The administrative organisation is ordinarily the same. At the head of each school is a Director, responsible for its control, who sees to the efficiency of its courses; to its relations with the State, municipality, or district; and to its relations with the general public. He may also be an instructor in one or more of the courses given therein.

The instruction is usually both general-theoretical, technical, and practical. It is given in day-courses, evening courses, and Sunday morning courses.[1]

It will suffice to take a few examples, practically at random, to illustrate the general ideas of technical education in Germany, and among these will be included what may be called technical middle schools; that is to say, schools which, though below the grade of technical universities, are above the grade of trade schools.

3.

[1] The feature of Sunday morning-courses is a somewhat widespread one in Europe. So far as the Commissioners could learn, such courses are always held in the forenoon. Much of the instruction which is given in the "Sunday School" of English speaking people is, on the other hand, more systematically given in the week days of the Continental chool, and the religious element, on the whole, is more uniformly distributed throughout the week.

3. *The Industrial Schools of Hamburg.*—The provision for industrial and technical education in Hamburg is as indicated by the following educational establishments, viz.:—

I. The *Baugewerkschule* (Builders' School).
II. The *Technikum* (Technical School), which includes courses in—
  (a) *Höhere Maschinenbau* (Higher Engineering Construction).
  (b) „ *Schiffmaschinenbau* (Marine-Engine Construction).
  (c) „ *Schiffbau* (Ship-building).
  (d) „ *Elecktrotechnik* (Electrotechnics).
  These (a) to (d) are *middle* schools, not merely schools for artisans.
III. *Wagenbauschule* (Carriage-builders' School).
IV. *Kunstgewerbeschule* (School for the artistic industries).
V. *Tagesgewerbeschule* (Day industrial school).
VI. *Abend-und. Sonntagsgewerbeschulen* (Evening and Sunday industrial schools).
  There is a head school (Hauptschule) and a number (9) of auxiliary schools.
VII. *Kaufmännische Fortbildungsschulen* (Commercial continuation schools).

There are 7 of these commercial schools. Schools I and VI have existed since the year 1865; II, III, and IV since 1895; V since 1881; and VII since 1898.

A general idea will be given of these.

4. *Hamburg School for Master-builders or Architects.*—The character of this school is well indicated by its programme, which is as follows:—

Programme of the "Baugewerkschule" at Hamburg.

Subjects.	Classes and Hours per Week.			
	IV.	III.	II.	I.
Writing	1	...	...	...
German	3	...	...	...
Business matters	...	2	1	1
Book-keeping	...	...	2	1
Arithmetic	2	2	...	...
Algebra	4	3	2	...
Geometry	4	3	1	...
Trigonometry	...	1	1	...
Mathematical exercises	...	...	...	4
Physics	3	...	...	1
Chemistry and theory of building material	...	...	3	1
Constructional mechanics, or statics	...	4	...	...
Theory of elasticity	...	...	3	...
Graphical statics	...	...	2	3
Statistical calculations in connection with building construction	...	...	...	2
Freehand drawing	4	4	4	...
Compass drawing and descriptive geometry	8	4	2	2
Stone-cutting	...	...	2	...
The theory of building construction	5	6	4	4
Architectural drawing	9	8	6	4
Design of details in building construction	...	...	...	2
Building estimates	...	...	2	1
Building	...	...	...	2
Theory of the form of buildings	4	4	...	...
Architectural form	...	...	2	2
Architecture	1	1	1	...
Architectural drawing	...	6	...	...
Designs for buildings	...	...	10	13
Building-design, under examination	...	...	...	3
Surveying	...	...	...	2

The Winter course commences in November and ends in March, the Summer course in April and ends in September. The instruction is given between 8 and 12 in the morning, from 2 to 6 in the afternoon. After passing each of the three lower classes, the pupil receives a certificate. By an Examination-Regulation of 24 April, 1896, the Leaving-Examination (Abgangsprüfung) takes place in co-operation with examinations held by the Bauhütte zu Hamburg. The school fees amount to 90 marks (£4 10s. 0d.) for each class. Pupils are recommended to attend the evening and Sunday morning instruction in the *Gewerbeschule* or the *Tagesgewerbeschule* as a preparation for the *Baugewerkschule*.

5. *Work in the Individual Courses.*—A fair understanding of the real nature of the work can be had only by taking the courses in detail. This will be done with great brevity.

Writing—
Class IV. Round hand for architectural drawings.

German—
Class IV. Orthography. Exercises having regard to technical phraseology, including that from foreign languages. Grammar and etymology. Exercises in composition. Descriptions and letters.

 Business

Business Matters.—

Class III. Recapitulation of orthography and grammar. The ordinary forms of business correspondence, etc. Bills, receipts, obligations, surrenders, amortisations, completions, business letters, news, attestations, etc., etc.

„ II. Theory of exchange. General observations on the origin, existence, and kinds of exchange. Law thereof. Preparation of official returns. Introduction to the exhibition of an explanatory statement in connection with the architectural drawings for a house.

„ I. Continuation as to official return. Technical language and matters to be attended to in buildings, operations, and explanatory statements in connection therewith.

Book-keeping.—

Class II. Opening up a set of books in the system of double entry for a carpentry or a builder's business. Closing the books and striking the balance.

„ I. Recapitulation and continuation of the subject in closing a set of books in balancing. Important commercial laws.

Arithmetic.—

Class IV. The four fundamental rules, with ordinary and decimal numbers. Simple and compound proportion. Calculation of areas.

„ III. Recapitulation and proportion. Calculation of interest, discount, exchange, and partnership. Calculation of surfaces and volumes. Extraction of the square and cube roots with whole and decimal numbers.

Algebra.—

Class IV. The four fundamental operations with general numbers. Use of brackets. Applications to sums, differences, products, and quotients. Theory of indices. Equations of the first degree, with one and several unknowns, and their application. Proportion.

„ III. Recapitulation of the theory of indices. Theory of roots. Recapitulation of the first degree equations, equations of the second degree with one unknown.

„ II. Recapitulation of equations, second degree equations with several unknowns. Theory of logarithms, progressions, and calculation of interest.

Geometry.—

Class IV. (i) *Planimetry.* Congruence of triangles, parallel lines, angles, triangles and polygons, parallelograms and trapeziums, theory of circles, contents of rectilinear figures, the Pythagorean theorem, proportional lines and similiarity of figures, regular polygons, calculation of the circle. (ii) *Stereometry.* The laws concerning lines, surfaces, and dihedral angles.

„ III. Recapitulation of the principal propositions of planimetry and the elements of stereometry, and continuation of the laws of the straight line, surface and solid angle. The most important polyhedrons and bodies with curved surfaces. Calculation of the surface and volumes of plane bodies, with plane and curved surfaces.

„ II. Recapitulation and also completion of stereometry.

Trigonometry.—

Class III. The trigonometrical functions and their limits. Calculation of right-angled and oblique-angled triangles. Regular polygons, circular arcs, circular sectors and segments by means of trigonometrical functions.

„ II. Recapitulation of the work in the previous class. Calculation of rectangular, isosceles, and oblique triangles by means of logarithms. The most important formulæ of goniometry.

Mathematical Exercises.—

Class I. Recapitulation of the most important elements of algebra, planimetry, stereometry, trigonometry; and the application of mathematical laws to the solution of such problems as occur in practice.

Physics.—

Class IV. General properties of bodies, system of weights and measures, density; the calculation of absolute weight; the solid state. The most important laws of gaseous and fluid bodies, and of electricity, sound, light, and heat.

„ I. Repetition of the matter treated in Class IV. Completion of the theory of electrical phænomena. Mechanical work, in so far as it is important in building construction.

Chemistry and Theory of Building Material.—

Class II. The most important features of inorganic chemistry. Building stones, woods, and metals; specially iron and the various kinds of mortars and cements. The working of these materials, their testing and use. The changes that take place in such material, and means of guarding against them.

„ I. Recapitulation and continuation of the preceding. Constructional mechanics, or statics (" *Baumechanik Statik* ").

„ III. The composition and decomposition of forces by calculation and drawing. Equilibrium in planes. Tensions in parts of simple constructions. Determinations of reactions. Significance and deduction of bending moments. Determination of centres of gravity. Calculation of the surface and volume of solids of revolution. Stability of walls. The most important elements of the theory of simple and compound machines.

Theory of Elasticity.—

Class II. The general properties of solid bodies. Elastic resistance in tension, compression, bending, and crushing. Calculations in cases of simple constructions.

Graphical

Graphical Statics.—

Class II. Recapitulation of the fundamental ideas of mechanics; parallelogram forces. Composition and decomposition of forces in a plane. Polygon of forces. Exercises in finding the centre of gravity. Investigation of reactions, of bending moments. Sectional strength, dangerous section in the case of a beam subject to a single and to a uniformly distributed load. Determination of moments of inertia.

„ I. Recapitulation. Stresses in simple structures. Ritter's method of calculating stresses. Calculation of stresses in roof trusses having regard to wind pressure. Investigation of stability in the case of walls subject to earth and water pressure or to the pressure of arches.

Statical calculations in connection with Building Construction.—

Class I. Application of the theory of elasticity to the scheme of statical calculation to all parts of building construction.

Freehand Drawing.—

Class IV. Outlines from wood and simple plaster models.

„ III. Drawing from plaster casts of building ornamental details in outline and also shaded.

„ II. The sketching of building ornaments and ornamental architectural features with pencils, crayons and pen.

Compass Drawing and Descriptive Geometry.—

(i) *Compass Drawing.* The most important constructions in a plane. (ii) *Descriptive Geometry.* General outline and simple exercises. The idea and purpose of projection. Simple bodies and their representation in orthogonal and oblique projection. Laws and exercises, problems on the projection of points, straight lines and planes. Intersection of straight lines and planes, projection of solids, the plane section of solids.

Class III. Exercises, brief recapitulation. The intersections of bodies, having regard to practical cases in connection with arches, roofs, etc. Construction of shadows.

„ II. Brief recapitulation. Continuation of shadow construction. Introduction to perspective. Perspective projection by sectional method. Perspective projection of simple architectural objects, introducing the principal point, distant and vanishing point, etc. Construction of shadows for perspective projection.

„ I. Recapitulation of the principal parts of descriptive geometry with solution of problems concerning the intersection of solid bodies. Shadow construction and perspective projection.

Stone-cutting.—

Class II. Explanation of its practical signficance. Stone cutting for ordinary walls, for rectangular and oblique arches. Elliptical arches. Straight and oblique vaulted roofs, symmetrical and unsymmetrical, Gothic vaults and winding staircases. The most important kinds of building-stones; the making of models in their natural size

The Theory of Building Construction.—

Class IV. The construction of walls. General observations on materials and the means of bonding them. Brick-walls. Rules for bonding and various kinds of bonds. Walls with ordinary bricks. Brick-arches. Walls with projections of ordinary brick. Walls of freestone and other kinds of stones. Rules for bonding. The working of stones for house-building. Lifting cranes, and their arrangement. Mixed wall-work. Bonded arches. Voids for windows and doors. Stone bonding. Pisé and concrete walls. Reparation work. Walls from loam, calc-sand, and "beton."

Carpentry.—

Class IV. General, concerning building timbers and their working-up. Scarfs and joints. Construction of partition walls. Wood walls of various kinds. Walls with mixed materials. Simple joists, roofing and roof-structures of various kinds.

„ III. Wall construction, vaulted forms, arches with various materials. Stone staircases, spiral staircases, and various stones for materials. Various forms of roof structures with straight and curved members. Wooden staircases, straight and spiral. Roof covering of various kinds. Glass roofs, skylights, etc., guttering, lightning-conductors, weather-cocks, etc.

„ II. Iron constructions. The manufacture of iron. The joining of iron plates, bolts, nuts rivets, etc. Flooring construction with the use of iron, girders and columns. Floors of iron and wood; iron and stone, etc. Galleries, balconies, etc. Roofs. Roofs of wood and iron and of iron alone. Iron stairways, straight and winding. Floors of wood and stone for dwelling-houses, hotels, etc. Doors, gates, and windows in wood and iron. Covering of partitions with stone, wood, cement, glass, etc. Painting with oil-colours, distempers, etc.

„ II. Water and heating services, and the artistic lighting of a building. General house-service. The installation of baths and private cabinets. Heating arrangement for dwelling-houses and public buildings. Individual and general heating. Ventilating arrangements. The installation of gas lighting and electric lighting. Examination of the building site. Value as foundations of various kinds of ground. Description of fundamental methods of making foundations. Use of piles, concretes, etc. Description of the most important methods of dealing with foundations. Protection against damp, etc.

Architectural Drawing.—

Class IV. Details concerning the bonding of stone, the angles of walls, voids for windows and doors, crossed walls, strengthening arches, etc.; projections, etc., of various stones; the construction of floors, walls, balconies, roofs, etc.

„ III. Details concerning ceilings and their construction. Special constructions in cases of roofs of great width, of halls and ceilings of various kinds, of roofs of various construction, and covering of wood and stone stairways.

„ II. Floors, galleries, balconies, roofs, and stairs in which iron is used as an auxiliary. Doors, gates, windows, and wall covering.

„ I. Working out of problems and the different parts of building construction. Design and building construction.

Design of Details in Building Construction.—

Class I. Working out of sketches in given problems, as well as a recapitulation of the most important parts of building construction. This is specially designed to afford individual exercise in the solution of important practical questions. Critical examination of the solutions.

Building Estimates.—

Class II. General, concerning provisional and exact estimates. The determination of quantities and prices. Introduction to the calculation of quantities and cost of parts of an hotel building, worked out from the architectural drawings.

„ I. Continuation of the preceding.

Building.—

Class I. The various works to be undertaken in connection with building. Drawings. Reports to authorities, etc. Estimate of cost. The distribution of the various works. Building contracts. Bookkeeping. Correspondence. The most important features of a technical conduct of actual building construction. Most important laws concerning building. Principal building laws. Building police (*Baupolizei*). Laws relating to accident.

Theory of the Form of details of Buildings.—

Class IV. General remarks concerning the form of buildings. Practical exercises in the drawing of the various architectonic features.

„ III. Columns, beams, joists, etc. The different orders of columns, according to Vignola. Arcades. Architectonic development of the various parts of the buildings. Practical exercises. The drawing of the various orders of columns, of windows, doors, etc., with application of columns, and various other parts of professional drawing.

Architectural Form.—

Class II. Historical and technical development of the art of building prior to the Christian era. Characteristic forms of the latest and most important monuments.

„ I. Special consideration of the ancient Christian, Roman, and Gothic form of buildings, as well as those of the Renaissance. Parts of buildings. Agricultural architecture. Introduction. The general arrangements of the buildings. Stall arrangements for horses, cattle, sheep, pigs, and poultry. Barns, stables, etc.

Building.—

„ III. General, concerning the arrangement of a citizen's house. Development of the general idea. Dwelling and hotel rooms. Arrangement of workmen's houses. City houses, country houses, and villas.

„ II. Brief recapitulation concerning the arrangement of a *building*. The disposition of commercial houses, storehouses, restaurants, inns, schoolhouses, and hospitals.

Architectural Drawing.—

Class III. The development for masons, carpenters, etc., of working sketches for an hotel, in which stables, coachhouse, coachman's dwellings, and other similar space is to be provided.

Designs for Buildings.—

Class II. Introduction to the independent working out of a small detached dwelling house answering to a given programme. The development must shew the necessary constructions and architectonic details for its practical execution.

„ I. Independent working out of designs for dwelling and business houses according to given programmes. The preparation of the general design and details on a scale of 1 to 100, of the architectonic details to 1 in 20, and also to natural scale.

Building Design under Examination.—

Class I. The working out of sketches of various kinds of buildings by way of practice in quick and independent solution, and of minor exercises in design, and the extension of a knowledge in designing. Critical examination of the work.

Surveying.—

Class I. Practical exercises in surveying and levelling. Preparation of the plan of the building site, and levels of the profile of the ground.

From the above it will be recognised that the courses are broadly and liberally orientated. The work of the "*Technikum*" will be dealt with later.

6. *School for Coach-builders.*—The coach-building school of Hamburg is intended for the theoretical education of wheelwrights and coach-builders. It has two courses, each of a half-year. The programme is as follows:—

Programme of the "*Staatliche Wagenbauschule zu Hamburg.*"

Subject.	Classes and Hours per Week.	
	Lower.	Upper.
German	3	3
Arithmetic	3	3
Freehand and Ornamental Drawing	6	6
Geometrical Drawing	6	6
Instructional Drawing of individual parts of the carriage ...	12	...
Theory of construction	6	4
Drawing designs and details of a complete carriage	...	12
Inner and outer treatment of a body of a carriage	...	1
General information as regards carriages	...	1
Totals	36	36

The subjects are taken as follows:—

The *German* is somewhat technically orientated, and in the second year deals with matters connected with *business.* An introduction to the theory of exchange is even introduced under this heading.

Arithmetic is taken in the lower class as far as the calculation of interest; and in the upper class calculations of discounts, of exchange, partnerships, of surfaces and volumes of bodies, are undertaken.

The *freehand and ornamental drawing* in the lower class is from wooden models, and from plaster casts and ornaments. In the upper classes the work includes coloured surfaces, ornaments, monograms, and heraldic arms.

The *geometrical drawing* in the lower class includes constructions in a plane, right and oblique projections of geometrical bodies, and simple details of a carriage. In the upper class, sections of solid bodies, their interpenetration, and the construction of shadows, are dealt with.

In the *constructional drawing*, the course is not the same for wheelwrights as for coach-builders. The latter is expected to take a course in measuring simpler iron parts in coach-building for the purpose of drawing them. It includes also the drawing of various iron and wooden parts having reference to the work in the smithy.

The *theory of construction* includes the arrangement and fitting of all parts of a carriage. In the upper class vehicles of all kinds are dealt with. The inner and outer treatment of the carriage-body for all kinds of vehicles is considered. In regard to the lacquering of carriages, the methods in vogue in Germany, France, England, and America are all discussed. The question of colour and tone is also elaborated.

The *drawing, design, and details of a vehicle* complete, are taken in the upper class. The woods and their preparation for the body of the vehicle are illustrated by models. Plan drawing for various vehicles on a scale of 1 in 4, or on a natural scale, are made. Designs and details in plans, side elevation, and end view are made on a scale of 1 in 5, or 1 in 10, the details of important parts of the iron-work being to natural scale.

Modern forms of vehicle, etc.

The instruction for both classes commences in May and in November. The pupils get a class-certificate for passing the first class, and a final certificate after passing also the second examination. The fee for each is 50 marks (£2 10s.).

7. *School for Artistic Industries, Hamburg.*—The Hamburg school for artistic industrial education is intended for such callings as decorative painting, cabinet-makers, sculptors, wood-carvers and modellers, metal workers, etc.

The courses given in the school are as in the programme hereunder, those in anatomy and proportion, in pose, and costume drawing being given in the evening from 7 till 9; all others in the day from 8 till 12 or 2 till 4.

The fees are 4 marks (4s.) monthly.

There is a museum in the school for art and industry (*Kunst und Gewerbe*), the objects in which are requisitioned as required.

The

The programme of subjects is :—

Courses in the "Staatliche Kunstgewerbeschule zu Hamburg."

Subject.	Hours per Week.
Ornament and figure drawing	30
Anatomy and theory of proportion	2
Pose—Drawing	6
Pose—Painting	12
Costume drawing	4
Drawing, water-colour and oil painting (living plants)	18
Water-colour and oil painting (still life)...	18
Conventionalising plant forms	12
Design of ornament and decorations	30
Drawing of monograms, heraldic drawing	6
Designing placards, title-pages, addresses, diplomas, etc. ...	12
Measuring, drawing, and designing art-industrial objects ...	12
Design, and detail of furniture and similar objects	20
Modelling ornamental, figure, and art-industrial objects ...	24
Chasing	8
Theory of style, form and colour	4
Heraldry	2
History of art	2

8. *The Day Industrial School, Hamburg.*—This school has summer and winter courses in the subjects shewn in the programme hereunder. The instruction is given between 8-12 a.m. and 2-4 or 5 p.m., the fee being 24 marks (24s.) half-yearly. When there is room, the pupils are allowed to attend also the evening schools and Sunday-morning schools at the principal industrial school (*Hauptgewerbeschule*). The subjects are as follow :—

Courses in the "Staatliche Tagesgewerbeschule zu Hamburg."

Subject.	Hours per Week.	
	Summer.	Winter.
German language	6	6
Arithmetic	6	6
Area and volume calculation	2	2
Book-keeping	2	2
Ornamental and round writing[1]	2	4
Algebra	6	6
Geometry	6	6
Freehand aud ornament drawing	36	46
Compass drawing and theory of projection	48	66
Elements of technical drawing	6	26
Elements of modelling	24	24

9. *Evening and Sunday-morning School, Hamburg.*—The instruction in this school is given from 7–9 in the evenings, and on Sunday morning 8·30 to 12·30. The summer half-year commences in the middle of March, and the winter semester in the middle of September.

The

[1] The ordinary German writing, *i.e.*, in German character, is angular.

The programme of subjects is as follows:—

Courses in the "Staatliche Abend-und Sonntagsgewerbeschulen zu Hamburg."

Subjects.	Hours per Week. Summer.	Hours per Week. Winter.
German language	14	18
Commercial correspondence, etc.	2	4
English language	10	8
French language	8	4
Writing	10	12
Book-keeping (ordinary industrial)	2	3
Arithmetic	14	18
Theory of geometrical forms	2	4
Algebra	20	18
Geometry	20	18
Trigonometry	4	4
Mathematical exercises	12	12
Introduction to physics	2	2
Theory of heat	2	2
Optics	?	?
Electricity and magnetism	2	2
Mechanics and theory of elasticity	4	6
The elements of machines	4	4
Mechanical technology	2	2
Chemistry	4	4
Laboratory practice in chemistry	4	4
Freehand drawing	68	92
" " for teachers (both sexes)	12	12
Methodology and teaching material for drawing	2	2
Freehand drawing for boys	12	12
Compass drawing and theory of projection	86	104
" " for boys	12	12
Descriptive geometry	12	12

The above are the general subjects. Then there are special subjects, as follow:—

Subject.	Hours per Week. Summer.	Hours per Week. Winter.
Builder (including theory of building construction)	4	4
Carpenter and joiner	40	48
Turner	8	8
Glazier	12	14
Upholsterer and upholstering decorator	8	8
Coach-builder and smith	12	12
Shipbuilder	12	16
Engineer	30	32
Locksmith	12	16
Tinsmith	14	14
Fine mechanician and worker in electro-technics	12	12
Watchmaker	4	4
Gardener	—	8
Tailor	2	2
Ornament drawing and design	48	58
Drawing in the Zoological Gardens[1]	4	4
Conventionalising plant forms	12	12
Drawing and design of art-industrial objects	12	12
Decorative painting	20	26
Drawing of figures and similar objects	20	22
Anatomy and theory of proportion	2	2
Costume drawing	4	4
Pose drawing	6	6
Letter drawing and sign painting	12	12
Letter drawing and heraldic drawing	12	12
Lithographing	8	8
Photolithography, zincography, and phototypography	4	4
Modelling in clay, wax, and lead	18	18
History of art	2	2
Technical information for glaziers, etc.	...	1
" " for gold and silversmiths	...	1
Professional drawing and modelling for gold and silversmiths	...	8
Physics for gold and silversmiths	...	1

[1] Attention is directed to this.

10. *The "Technikum" of Hamburg.*—The Technikum deals with a higher class of work than is done in the Gewerbeschule; and yet it is hardly a Technical University as will be seen from the details of the courses. It is what may be called a *secondary* school of technology, and it is really so called in Hamburg.[1]

It will be necessary to give an outline of the various courses, and this is important, since they reveal the distinction between an ordinary industrial or trade school, a secondary school of technology, and a Technological University.

The various sections of the "*Technikum*" have already been mentioned in section 3 of this chapter. They will be referred to in the order there indicated.

11. *Higher School for Engineering Construction, Hamburg.*—This school has for its object the theoretical education of those who hold positions as heads or overseers in technical businesses, or wish to become mechanical draftsmen, etc. The school has four half-year classes, and promotion from class to class is determined by the instructors in conference. The fees are 72 marks (£3 12s.) half-yearly, payable in advance. Admission to the commencing class reduces the military service to one year. Those who have not passed the "*Einjährige Examen*" in the ordinary school, pass a special examination.

Each scholar takes all the subjects in the several classes, which means devoting forty-two hours per week to his work. The courses begin in Easter and Michaelmas.

The following is the programme of studies:—

Programme of the Höheren Maschinenbauschule zu Hamburg.

Subjects.	Classes and Hours per Week.			
	IV.	III.	II.	I.
German	2	2	2	...
Algebra	3	...	...	...
Planimetry	1	...	...	...
Stereometry	2	...	...	...
Trigonometry	2	...	...	...
Algebraic analysis	...	3	...	...
Algebraic geometry	...	3	...	...
Mathematical exercises	3	2	2	2
Mechanics	3	6	4	3
Chemistry	2	2	1	1
Physics	3	3	1	1
Electro-technics	...	...	3	2
Technology	...	...	3	4
Descriptive geometry	9	4	...	...
Elements of machines—Lectures	2	5	...	...
Exercises	8	10	...	...
Steam-engines—Lectures	...	...	6	2
Exercises	...	...	3	14
Cranes and lifting machinery and pumps—Lectures	...	...	4	2
Exercises	...	...	7	...
Water motors and small motors—Lectures	...	...	...	2
Exercises	...	...	...	2
Boilers and heating apparatus—Lectures	...	...	3	1
Exercises	...	...	3	4
Building construction	2	2	...	...
Estimates	...	...	...	2
Practical geometry	...	...	2	...
First-Aid course	...	...	1	...
Totals	42	42	42	42

12. *Details of Course in Engineering Construction.*—The following details will be sufficient to give an idea of the way in which the work is dealt with:—

German—

Class IV. Exercises in oral and written composition, in business correspondence, official returns, letters of acknowledgment, and what may be called general technical correspondence.

„ III. Important matters relating to industrial business. Questions touching legal procedures, communications with authorities, workmen's laws. The German law of exchange.

„ II. Book-keeping. Proceedings in cases of bankruptcy.

Algebra—

Class IV. Recapitulation. The work done includes equations of the second degree with several unknowns, logarithms, progressions, calculation of interest, annuities, etc.

Planimetry—

Class IV. Recapitulation of the whole of planimetry and the applications of algebra and geometry thereto.

Stereometry—

[1]For example, Die elektrotechnische Schule zu Hamburg ist eine technische *Mittelschule*.

Stereometry—

Class IV. Straight lines, planes and solid angles, surfaces and volumes of the most important bodies. Prisms, pyramids, prismatoids, cones, cylinders, spheres, paraboloids, etc.

Trigonometry—

Class IV. The trigonometrical functions, right angles and oblique-angled triangles, goniometry and its application to trigonometry.

Mathematical Exercises—

Class IV. Independent solutions of problems in algebra and geometry.
„ III. More advanced solutions of various kinds.
„ II and Class I. Work of a more advanced character.

Algebraic Analysis and Analytical Geometry—

Class III. Theory of combination, binomial theorem, higher arithmetical series. Cubic equations, infinite series. Co-ordinates, points, straight line, circle, the conic sections and other practically important curves.

Mechanics, and Graphical Statics—

Class IV. Parallelogram of forces, statical moments, centre of gravity, equilibrium of solid bodies, simple machines, friction, composition and decomposition of forces by means of the force polygon, stresses in technical work.

„ III. Tensile and compressive strength, resistance to bending elastic extension, torsional rigidity, crushing strength, determination of statical moments, sectional strength and bending moment of a simple girder with a dead load. Graphical determination of the centre of gravity and of the moments of inertia of services. Graphical investigation of a tall chimney.

„ II. Theory of uniformly accelerated motion, trajectories, mechanical work, law of acceleration, laws of impulsive forces, *vis viva*, centrifugal force, rotation about a fixed axis, moments of inertia, theory of impact, equilibrium motion of a fluid and gaseous bodies.

„ I. Recapitulation, and solution of problems.

Chemistry—

Class IV. Starting from air, water, carbon, hydrochloric acid, etc., the fundamental laws of chemical phænomena are explained by experiments. The properties and most important combinations of the non-metals. Oxygen, nitrogen, hydrogen, carbon, sulphur, phosphorus, chlorine, iodine, bromine, fluorine and silica are treated specially in regard to their importance to technology.

„ III. Properties of metals and their most important combinations.

„ II. Elementary treatment of technical chemistry. Water, its distillation and filtration and purification of water for boilers. Natural and artificial combustible materials. Coal, illuminating gas, water gas, petroleum, benzene. Comparison of the energy of heat, gun and smokeless powder, dynamite, glass manufacture.

„ I. Recapitulation, and practical exercises.

Physics—

Class IV. Beginning with the general properties of bodies, such as impenetrability, divisibility into the molecule and atom, porosity, cohesion, adhesion, capillary force, solidity and elasticity, the course passes on to consider systems of weights and measures, force of gravity, absolute and specific weight, etc. The following are then dealt with:—Fluid bodies, the transmission of pressure, hydraulic press, communicating vessels, determination of specific weight, areometer, gaseous bodies, atmospheric pressure, Mariotte's and Gay-Lussac's laws, pumps, fire-engines, manometers, air-pumps. The weight of bodies in the air, air-balloons. Action on fluids by means of the efflux of gases. Rock-drills, injectors, etc.

„ III. The theory of heat, expansion, thermometry, calculation of the change of bodies through heat, exceptions, changes of gaseous pressure through heat. Laws of Mariotte and Gay-Lussac. Change of solids into fluids. Unit of heat, melting point and heat of fusion, frigorific mixtures, boiling and evaporation, cooling by evaporation, ice-machines, properties of steam, steam as a moving power. Specific heat, calorimeter, determination of high temperatures, propagation of heat by conduction, radiation and conduction. Heat-waves, heat as an entity, relation between heat and work, mechanical equivalent of heat, heat phænomena in the atmosphere, winds, sea-currents, terrestrial heat.

„ II. Optics, the propagation of light, intensity, laws of reflection, plane and curved mirrors, law of refraction, refraction of lenses and prisms, colour dispersion, important optical instruments and theory of sound.

Electro-physics—

Class II. Magnetism, frictional electricity, atmospheric electricity, fundamental laws of current electricity, galvanic elements and accumulators, Ohm's law. Arrangement of the elements, electric current.

„ I. Continuation of the theory of electricity. Electro-technics, electro-motors.

Mechanical Technology—

Class II. Iron-mining, iron-smelting and founding.
„ I. The preparation of metals and woods, machines and workshops.

Steam-engines—

Class IV. Elements of machines. Minor details of machines.
„ III. Extension of the previous subject, dealing with the principle of the more important mechanical contrivances.

 Theory

Theory of Steam-engines—

Class II. Various kinds of steam-engines, computations in regard to the constructions of various parts, condensers, fly-wheels, regulators, general arrangement.

„ I. Compound engines. The investigation of the steam-engine. Design of a steam-engine with its various parts.

Boilers and Furnaces—

Class II. Combustion material, theory of combustion, the principal furnaces and their action, flues and chimneys, the most important types of boilers.

„ I. The adjuncts of a boiler, building in position. Maintenance, laws relating to boilers, the most important elements of the technics of heat.

Estimates—

Class I. Cost of installation of machinery.

First-Aid Course—

Class II. This course is both theoretical and practical and the students go through practica exercises in connection with it.

The above, although it does not exhaust the subjects of the programme, gives a sufficient indication of the thoroughness with which the various parts are treated.

13. *School for Marine Engine Construction, Hamburg.*—This school has two sections, each having half-year classes, demanding forty-two hours per week each. The instruction commences 1st November each year. The fee is £3 12s. half-yearly.

These courses are as follow, viz.:—

Programme of Courses of the "Schule für Schiffsmaschinenbau zu Hamburg."

Subjects.	Hours per Week.	Subjects.	Hours per Week.
First Half-year.			
Algebra	3	Marine boilers	4
Planimetry	3	Electro-physics	4
Stereometry	2	Electro-technics	4
Trigonometry	2	Machine drawing	3
Mechanics	6	Ship-building	3
Mechanical theory of heat	2		
Marine engines	6	Total	42
Second Half-year.			
Analytical Geometry	3	Electro-technics	2
Analysis	3	Working out of results of trial trips	4
Mechanics	5	Descriptive geometry	3
Theory of machines	2	Drawing of machines	9
Marine engines	6		
Marine boilers	2	Total	42
Ship-building	3		

Second Section.

Lower Class.		*Upper Class.*	
Subjects.	Hours per Week.	Subjects.	Hours per Week.
Differential calculus	4	Integral calculus	4
Mathematical exercises	4	Mathematical exercises	3
Marine engines	6	Analytical mechanics	3
Marine boilers	4	Theory of engines	2
Ship-building	3	Marine engines	6
Designing of marine engines	15	Marine boilers...	2
Mechanical theory of heat	2	Designing of marine engines	15
Electro-technics	4	Ship-building	3
		Electro-technics	4
Total	42	Total	42

14.

14. *Details of Course, Hamburg School for Marine Engine Construction.*—It is not proposed to give the courses in full. It will be sufficient to refer to the way in which two or three of the subjects are taken, for this will give a definite idea of how the remainder are treated.

Marine Engines.—The course treats of the theory of marine engines, the state of the steam in the cylinders, the quantity of feed and condensing water, the use of coal, simple and expansion engines up to fourfold expansion, computations for vessels with screw-propellers and paddle-wheels, indicator diagrams, strength of various important parts of marine engines, calculations in regard to condensers, air-pumps, pumps, pulsometers, etc. Foundations of marine engines, their installation. Ship's propellers, the calculations of their proportions, etc., auxiliary engines on marine vessels, steam-steering gear, anchor hoist, air, ventilating, and electric and refrigerating installations.

Working out the Results of Trial Trips.—Rankine-ising ("*Rankinisiren*") of the diagrams, construction of the tangential diagrams. Calculation of the quantity of steam from the diagrams, construction of the curves for coal consumption and ship's velocity.

Differential Calculus.—Differentiation of algebraic, trigonometrical and exponential functions, the greatest and least values of functions. Apparently indeterminate forms. Application of the differential calculus to the development of series. Maclaurin's and Taylor's series, curve tracing with plane curves, radius of curvature.

Integral Calculus.—Simple integrals, integration by parts and by substitution, integration of algebraic, trigonometrical and logarithmic functions, definite integrals, application to the calculation of the length of arcs, area of surfaces, volume of solid bodies, etc., etc.

Electro-technics.—Most important laws of magneto-electricity and induction, etc., with special regard to their application, the dynamo-machines, the principle of the newer forms of dynamo for continuous current, the armature, magnetic field and reaction in the armature, description of an ordinary dynamo used on ships. Measuring instruments, the electric-bell and electric-lighting installation on ships, general theory of dynamos, alternating current and polyphase machines, electric motors for continuous and other transformers, accumulators, telegraph and telephone services on a ship.

Ship-building.—Practical ship-building, building and general arrangements of a steam-ship, water-tight compartments, etc., fire service, hygienic and ventilating arrangements, foundations for machines and boilers, steam-steering gear, theory of ship-building, calculation of displacement, centre of gravity and metacentre, calculation of list under various circumstances, strength and stability, resistance to motion, displacement theory, steam-line theory, resistance curves, steering gear.

Brief as is the above indication it is sufficient to shew how the work is taken.

15. *Higher Ship-building School, Hamburg.*—This school is also a technical middle school with four half-year courses, a school fee of £3 12s. per half-year, and the following programme, viz. :—

Programme of the "Höheren Schiffbauschule zu Hamburg."

Subjects.	Classes and Hours per Week.			
	IV.	III.	II.	I.
German	2	2	2	...
Algebra	3	...	...	...
Planimetry	1	...	...	...
Trigonometry	2	...	...	...
Stereometry	2	...	...	...
Algebraical analysis	...	3	...	...
Analytical geometry	...	3	...	...
Mathematical exercises	3	2	2	2
Mechanics	3	5	3	2
Chemistry	2	2	...	...
Physics and electro-technics	3	3	3	1
Technology	...	...	2	3
Descriptive geometry	9	4	...	...
Details of machines—Lectures	2	1	1	...
Exercises	4	3	3	...
Drawing of ships	4	5	7	9
The theory of ship-buildimg	...	4	2	2
Practical ship-building	2	5	12	12
Arrangement and equipment of the ship	...	...	4	2
Naval construction	...	...	...	4
Marine engines	...	...	...	5
First-Aid course	...	...	1	...
Total	42	42	42	42

So far as regards detail, these various subjects are treated much in the same manner as in instances previously quoted, and it is therefore unnecessary to elaborate them.

16.

16. *Higher School for Electro-technics, Hamburg.*—The electro-technical school in Hamburg is also a technical middle school, intended to meet the practical requirements of all those who have to do secondarily with electro-technical matters. The course is given in four half-year classes, the fee being £3 12s. per half-year, and the programme as given hereunder :—

Programme of the "Höheren Schule für Elektrotechnik zu Hamburg."

Subjects.	Classes and Hours per Week.			
	IV.	III.	II.	I.
German	2	2	2	...
Algebra	3	...	...	...
Planimetry	1	...	...	...
Trigonometry	2	...	...	...
Stereometry	2	...	...	...
Algebraical analysis	...	3	...	...
Analytical geometry	...	3	...	...
Mathematical exercises	3	2	2	2
Mechanics	3	5	3	2
Chemistry	2	2	2	1
Electro-technics	...	...	...	4
Physics	3	3	1	1
Electro-physics	2	2	2	...
Technology	...	...	2	3
Descriptive geometry	9	4	...	...
Part of machines, with exercises	8	11	7	...
Steam-engines	...	...	2	3
Boiler and heating apparatus	...	...	...	2
Water motors and small motors	...	...	...	2
Technique of electric currents of low potential	...	2	...	...
Accumulators	...	1	...	...
Electro-technics and technique of electric currents of high potential.	...	...	6	4
Distribution of current	...	...	...	4
Theory of measurement and measuring instruments	...	...	4	2
Constructions and calculations in electric machinery	...	...	...	6
The theory of building construction	2	2	...	...
First-Aid course	...	...	1	...
Practice in the electro-technical laboratory	...	...	6	6
Total	42	42	42	42

17. *Details of Course, Hamburg School for Electro-technics.*—Intuitional instruction is held to be especially important in the case of electro-technics, and for this reason there is an excellent electrical laboratory at the "*Technikum*" of Hamburg which the Commissioners saw. It occupied two rooms in the basement. Two gas engines, one of 12 H.P., and the other 2 H.P., a continuous current dynamo (8 k.w.), one of 600 volts for the arc lights, a third dynamo, a Schumann motor, a continuous current and an alternating current transformer, an alternating current machine, a "transasynchronous" motor, a single phase asynchronous motor, a transformer, measuring instruments, various kinds of lamps, a large number of laboratory instruments, and an accumulator-battery formed the main features of the equipment. A photometric room, and considerable means for carrying out electrical measurements are also worth special mention.

Touching the details of the course, it will suffice to make a very brief reference to one or two of the subjects.

Technique of Current of low potential.—Under this heading, house-telegraphy, telephone-systems, cable arrangement, electric clocks and signals, electric fire-alarms, and so forth are dealt with in Class III.

In Class II, under the heading of *electro-mechanics, and the technics of current of high potential,* the theory of lines of force, of induction, of capacity, of the development of continuous current, control, etc., and continuous current motors, construction, and computation in connection therewith are dealt with. In Class I the graphical theory of alternating currents, of single and polyphase generators, of transformers, of synchronised and induction motors, of electric railways, cranes, automobiles, etc., etc., are treated.

Electrical and other Measurements.—These include in Class II:—Resistance, current, potential quantity, etc. Galvanometers, accumulators, etc., are tested. The amperemeter, voltmeter, and wattmeter of all kinds are discussed ; and materials for putting in resistances, insulating, etc., and special instruments of various kinds are referred to. In Class I the work includes photometry, insulation measurements, magnetic measurements, determination of capacities, and induction coefficients, special measuremenents of alternating currents, measurements in connection with machines of various kinds, shunts, etc., lightning conductors.

Water

Water Motors and small Motors generally.—In Class I, Water-wheels, Pelton wheels, turbines, etc , are described ; also gas, petroleum, and benzene motors, hot-air motors, etc.

Electro-chemistry in Class I deals with the theory of electrolysis, and its applications, galvano-plastics, metallurgy, galvanic cells, and accumulators. In addition, practical exercises in the laboratory are undertaken.

The above is a sufficient indication of the special features of the school, the other subjects being treated pretty much as indicated in the outlines already given.

It should be mentioned in connection with the Hamburg school that experience in the lower type of school—*i.e.*, the Gewerbeschule—is regarded as valuable for those who have sufficient mental endowment to undertake work in the higher school. At the same time it is clearly recognised that even the higher courses are not technical courses of the highest character, and they cannot be regarded as competing with the courses in the technical high schools (Technischen Hochschulen), which are really technical universities and which now confer the diploma of doctor in several subjects.

18. *The Municipal Art-Industrial School, Strassburg.*—A type of school which may be quoted as also meeting the industrial requirements of the people, particularly where those requirements demand some artistic training, is the well-equipped school at Strassburg, known as the *Städtische Kunstgewerbeschule.* This school consists of nine divisions, viz. :—

(1.) General Preparatory division.
(2.) Division for simple decorative paintings and conventionalising of natural objects.
(3.) „ decorative painters.
(4.) Composition Division, including conventionalising from natural objects.
(5.) Division for women.
(6.) „ geometrical, architectonic, and art-industrial drawing.
(7.) „ ornamental modelling.
(8.) „ figure modelling.
(9.) „ figure drawing.

The Art-Industrial has four workshops, viz., one each for the following :—

(10.) Ceramics.
(11.) Art cabinet-making.
(12.) Artistic locksmithing and similar work.
(13.) Chasing and artistic goldsmith's work.

There is further a course in the theory of style and the history of art.

Pupils are admitted at Easter and Michaelmas, but may, in exceptional cases, be admitted at any time. They must have discharged their elementary school-obligation, and be at least 14 years of age. Regular attendance is compulsory, and the administration has the right, should it be dissatisfied with the attendance, to dismiss the pupil and return his fee. Scholars of both sexes pay 50 marks (£2 10s.) per half-year and occasional students 20 marks (£1) per year, but they have not the privileges of regular students.

The school has a four-year course, the first two years being devoted to natural history and science studies, having regard to the subject, the third year shewing the application of natural forms to industry. The fourth year is devoted to practical work in special features. The instruction is invariably individual. In the next section is given a general idea of the courses.

19. *Details of Courses, Strassburg Art-Industrial School.* — General Preparatory Division. Elementary drawing, drawing from plaster casts, treatment of shadows, of simple surfaces, outline drawing of easy natural forms such as leaves, flowers, branches, drawing with pen and pencil, crayons, water-colour exercises, linear and compass drawing, plane geometry, projection drawing, geometrical shadow construction, theory of illumination, commencement of architectural drawing. All these are done in the Summer Semester.

In the Winter Semester the drawing is more advanced ; it includes the application of natural forms, easy compositions, etc.

Divisions (2), (3), and (4) sufficiently explain themselves. Division (5), viz., the *Course for Women*, is as follows :—

Summer Semester.—

Drawing of natural objects, fruits, flowers, etc., and also their representation in plaster, plants from nature, figures from plaster casts, drawing and painting from the living model.

Conventionalising and designing from nature, with special regard to the practical application of such studies for needlework, embroidery, artistic trimming, etc.

Painting of flowers, fruits, and still life from nature and in water-colours, oils, etc. Application of the various studies to art-industrial purposes. Landscape drawing and painting from nature. Preparatory instruction for female teachers of drawing. Geometry and geometrical drawing, drawing on the blackboard and drawing of solid objects—methodology.

Winter Semester.—

Drawing of objects and still life from nature, plaster casts, ornaments, fruits, and flowers. Figure drawing from plaster. Drawing and painting from the living model in pastels, oils, etc. Drawing and designing for needlework, embroidery, etc., and application of same.

Painting of fruits, animals, still life, etc , from nature, in various media. Application to art-industrial purposes.

Passing

Passing over sections (6) to (9) and turning to that of *ceramics*, it may be said that the pupils begin in the Summer Semester with the simplest forms, and then proceed to the more difficult ones. Furnace work at different temperatures proceeds continuously with the general work. The modelling of leaves, flowers, fruits, muscles, animals from nature, as well as of ornaments in various styles, and the preparation of plaques, vases, medallions and friezes are undertaken, and also decorative reliefs and masques for faïence, and wall decorations or room ornaments.

Lead-glazing and glazing without lead, first colourless and later coloured, the management of the glazing furnace, the glazing of earths at various temperatures, are also subjects of practical study.

The modelling of flowers, of vases, plates, plaques, wall-decorations, decorations for air-heating apparatus, of decorative ornaments, and of architectural ornaments from nature is a feature of the work, and so also is drawing of the various architectural styles.

Sections from (11) to (14) do not call for special comment.

20. *Concluding Remarks.*—The work seen by the Commissioners at this school was excellent, and practically the same observation can be made for most of the other schools visited. It may also be added that work of this type seen in the Exhibition of Düsseldorf and that of Turin[1] by the Commissioners was excellent, and afforded evidence of the fact that the art and technical courses are already bearing fruit.

Examples from other towns of Germany, visited by the Commissioners, could be given, but such multiplication of instances would not serve any useful purpose. It is sufficient to remark that the cases cited may be taken as illustrative, they are not in any sense special.

---

[1] Some of the most beautiful art-industrial work came from Munich.

CHAPTER IX.

CHAPTER IX.

Continuation, Trade, and Lower Technical Schools of Paris.

[G. H. KNIBBS.]

1. *Introduction.* — Although the various schools of Paris do not exhaustively represent the provision made in France for the education of the French people, they stand much in the same relation to the educational provisions of the rest of France as do the schools of Berlin and its suburbs to those in other parts of Germany. Recently there has been considerable progress.

Notwithstanding the brilliancy of French achievement in higher education, and in the development of higher knowledge, and the early organisation of its educational system, and notwithstanding the splendid contributions made to applied science, especially in agriculture, etc., technical education has been adequately advanced only quite lately, viz., since the Franco-German war; and it is openly recognised by French educationists that the greatness of France's misfortunes was the stimulus to effort, and that they urged her to improve her methods of commercial and industrial education.

The various types of lower technical schools to be found in Paris are referred to in this chapter, commercial education, however, being excepted, as that subject is sufficiently dealt with in a later part of the Report.

2. *Recognition of the necessity of replacing apprenticeship by systematic instruction.*—During the liberal Ministry of Duruy, in 1868, an opinion grew up that the old scheme of apprenticeship must, *in the interests of national efficiency*, be replaced by systematic instruction. In 1872 that idea was accentuated by the disasters of the war, and M. Gréard, the then Director of Education, submitted a memorandum proposing the opening of a school for instruction in the wood and iron industries.

Even to those least prepared to accept the new idea, the advocacy of Gréard carried conviction. He demonstrated the national advantage of replacing the method of learning through apprenticeship by that of learning through such systematic instruction as could be imparted only in a properly developed school. He shewed that the existing means for preparing young people, on leaving the primary school, for their life callings were insufficient; that in the apprenticeship system, egoism operated in various ways strongly against the national interest; that the master of apprentices was compelled to sacrifice the welfare of his apprentice more or less to the exigencies of his business; that workmen, reacting to a narrow selfishness, and often incapable of perceiving the issue from the standpoint of national development, were hostile to apprentices, and were by no means friendly to their entry into the ranks of workmen; in fact, the old system of apprenticeship was subject to many defects, and, as a method of professional education, was intermittent, without order, and opposed to the interests of the people considered as a whole.

This led to the creation by the Municipality of Paris of the Diderot School (*Ecole Diderot*). The results achieved were very satisfactory. A special Commission was appointed by M. Hérold, then Prefect of the Seine, to study the question of the best means of securing good lower professional and technical education.

This led to the creation of the law of 11th December, 1880, dealing with manual schools of apprenticeship (*écoles manuelles d'apprentissage*), and the Commission declared itself in favour of the creation of further schools of the type of the Ecole Diderot.

Conformably to this decision, schools of industrial physics and chemistry, for example, Germain-Pilon and Bernard-Palissy, 1882, Boulle and Dorian, 1886, Estienne, 1889, and such schools as the professional schools for girls in rues Fondary, Bossuet, de Poitou, Bouret, Ganneron, and de la Tombe-Issoire, were started.

3. *The Ecole Diderot.*—The Diderot school, the first "professional" school created in Paris, had for its expressed object "the making of well-instructed and skilful workmen, capable of earning their living on leaving the school."

The instruction is both theoretical and practical. The pupils enter school at 7·45 a.m., and leave it at 6 p.m.; but there are two breaks, viz., 12–1·15 and 3·15–3·30. The school-year commences on 1st September and ends 31st July, the month of August being a vacation month.

The school claims to be, above all, a school of apprenticeship, the general instruction occupying only a secondary place. In fact, general instruction is reduced to the lowest limit, in order to allow the pupils to spend as much time as possible in the workshop.

The

The course is of three years' duration. The programme, which may be divided into two parts, viz., theoretical and practical, is as follows:—

Ecole Diderot.—Programme of Theoretical Instruction.

Subjects.	Year, and Hours per Week.		
	I.	II.	III.
Arithmetic and Algebra	2	1	1
Geometery	2	2	1
Theoretical and Practical Technology ...	3	1	1
Physics	...	2	...
Hygiene and Economics	...	...	2
Theoretical Mechanics...	...	1	...
Drawing...	4	4	4
French	1	1	...
History and Geography	1	...	...

The programme of Practical or Manual Instruction includes forge-work, turning (metal), fitting, etc, fine mechanical work, pattern-making, carpentry and joinery, locksmithing, brazier's work, and plumbing. During the first year, five and a-half hours are devoted daily to these; during the second year, six hours; and during the third, seven and a-half hours.

The organisation of the practical work is very good. The pupils, on arrival, are distributed among the nine workshops, where manual instruction is given. In each section a first-year pupil is placed, as soon as possible, between a second and third year pupil.

In the forges, first-year pupils are strikers, etc, make up the fire, and in this way become familiar with their later duties.

As far as possible the work done is utilised. The work, in detail, consists of parts of complete machines to be later fitted up.

A large part of the tools and machine tools in the establishment is the work of the pupils. As there is no foundry in the school the patterns made by the pupils are sent outside for the necessary castings, but the main part of the work is done in the school.

The work in the section of mechanics of precision comprises the making of geodetical and physical instruments. In these the last degree of care is necessarily taken as to exactness. Each student studies the tools he uses, first from a purely kinematic point of view, and then under supervision uses it for making a special piece of apparatus. In this way he better appreciates the conditions by means of which exactness is attainable.

The motive power is derived from two engines, a steam and a gas engine, each of about 15 h. p. A second and a third year pupil are required to attend to the steam-engine under supervision continuously for a week.

Twice a year the pupils of each section of the school execute the same piece of work, *i.e.*, there is one piece of work for each section. This is done from drawings or sketches and without explanation, and marks are given, and also money prizes, according to the quality of the work so determined. Besides this, marks are given for theoretical and practical work, conduct in class and workshop, and each pupil receives a monthly reward in money based thereupon.

At the distribution of prizes at the end of July each year, each pupil who has acquitted himself well, in respect of his theoretical and technical studies, receives an indenture of apprenticeship (*un brêvet d' apprentissage*), and further a sum of money, and such tools as will enable him to carry out his work.

Several times a year pupils of each section visit suitable industrial establishments, under the guidance of the appropriate instructors, who give such detailed explanations as seem to him necessary. Each pupil makes a report illustrated by sketches.

4. *The Ecole Boulle.*—Another type of apprenticeship school is the *Ecole Boulle*, a furniture and cabinet making school (*école d' apprentissage du meuble*). Though founded in 1886 it did not receive its present name till four years later, 1890, when it was so named in memory of an eminent Parisian cabinet maker—André-Charles Boulle (1642–1732). In 1896 it had a cabinet and furniture making department only. To-day it has also a metal department.

These departments are divided in all into eight divisions, for each of which the instruction falls under two distinct heads, viz. (i) manual and (ii) theoretical and artistic. Besides these, eleven hours a week are devoted during the first year to a recapitulation of the work of the primary school, the whole course lasting four years.

The manual instruction is given by master-tradesmen (maîtres-ouvriers).

The manual instruction is as follows:—

I.—Furniture Division—
(i) Cabinet-making; (ii) upholstering; (iii) wood-carving; (iv) joinery.

II.—Metal Division—
(v) Chasing, in its applications to furniture, art bronzes, gold and silversmiths work; (vi) mounting and setting; (vii) engraving.

III.—Wood and Metal—
(viii) Turning of wood and metal.

The time devoted to the above is, 1st year, 19 hours per week; 2nd to 4th year, 30 to 33 hours per week.

The

The theoretical and artistic instruction is as follows:—

(i) Geometry; (ii) Technology; (iii) Industrial economics; (iv) The history of art; (v) Decorative composition; (vi) Art drawing and water-colours; (vii) Modelling as applied to artistic cabinetmaking; (viii) Stereotomy as applied to furniture, *objets d'art*, grouping, etc.

From 3 to 6 hours per week are devoted to the theoretical work, and 12 to 17 hours to the purely artistic instruction; the total number of hours per week for each pupil being 51.

The aim of this school is to educate a superior class of workmen capable of maintaining the high reputation which the better types of Parisian artistic products and furniture have enjoyed.

5. *The Ecole Estienne.*—The Ecole Estienne is what is known as an *école du livre*, and has taken the name of a celebrated family of printers and publishers, whose first publications go back as far as the commencement of the 16th century. In 1881 the Municipal Council of Paris undertook to create a school the object of which was to educate artistic workmen, qualified not only to carry out the work of ordinary typographers, but also that allied sets. The school was opened in 1889, and in 1895 special buildings were erected covering about 3,256 square metres on a plot of about 5,600 square metres. The cost of the buildings was about £56,600 (1,415,959 francs). The budget for 1900 represented about £10,100 (253,205 francs), made up as follows, viz.:—

		£	s.	d.
Day Courses—	Staff	6,440	0	0
„ „	Material	3,420	0	0
Evening Courses—	Staff and Material ...	240	0	0
		£10,100	0	0

The course lasts 4 years and in certain cases may be extended to 5 years; and 75 to 90 pupils are admitted yearly. This will give some idea of the cost of training each pupil.

Admission to this school is by examination, the age must be between 13 and 16; the pupil must be French and domiciled in Paris or its environs.

Pupils resident in Paris are admitted free; the suburban communes must pay 200 francs (£8) per annum for each pupil resident in the suburbs.

Breakfast is furnished gratuitously to pupils resident in Paris; those from the suburbs must bring their breakfast, or pay at a rate fixed by regulation.

The instruction may be divided into two branches, viz., (i) Theoretical; (ii) Technical.

6. *Instruction in the Ecole Estienne.*—The theoretical instruction has for its object the completion of the general instruction of the "apprentices," and to give them those indispensable ideas which should be possessed by every workman who desires to excel in his craft.

The principal subjects taught are:—

(i) French language; (ii) History and geography; (iii) The reading of Greek for typographers; (iv) The conceptions of mathematics and geometry; (v) The physical and natural sciences as applied to the arts and to the publishing industry; (vi) The History of Art; (vii) The history of printing and publishing; (viii) Modelling; (ix) The drawing of ornaments, etc.; (x) Drawing at sight and industrial drawing; (xi) Gymnastic and military exercises.

The theoretical instruction is given every morning from 8·30 till 12·0, and is general for all pupils of the 1st and 2nd years. In the 3rd and 4th years, it is divided into three orders of special courses, viz., (1) for engravers, lithographers, gilders; (2) for compositors, photographers, photogravurists, etc.; (3) for typographic founders, copper-plate workers, etc. The courses are specially adapted to the practical requirements of each.

Pupils of the 3rd and 4th years take theoretical courses for 4 mornings a week; the whole of Friday and Saturday is passed in the workshop.

The technical courses occupy from 1 to 6 in the afternoon, Monday to Saturday inclusive, for all pupils. They embrace 15 different callings, viz.:—

Typography—Typefounding, composing and adjusting. Printing with hand and machine presses, photography and galvanoplastic work.

Bookbinding.—Bookbinding, gilding on leather. (Three special teachers also come once a week to give instruction in gilt-edging, marbling, chasing upon leather, etc.)

Engraving.—Engraving upon wood, engraving in relief, copper-plate engraving, printing.

Lithography.—Lithographic engraving, chromolithography, lithographic drawing, Lithographic writing, printing with hand and machine presses.

Photography.—Photography and such derivative processes as photogravure, phototyping, etc. (This part of the instruction does not aim at being completed in the school.)

7. *Examinations and discipline, Ecole Estienne.*—In each branch of the school there is an examination at the end of each 4 months (*trimestre*—really about $3\frac{1}{2}$ months), when the pupils are arranged in order of merit. Those who do not obtain sufficient marks, either repeat the work already gone through, or are dismissed from the school, at the discretion of a superintending council (*Conseil de surveillance*).

The final diplomas are a diploma of honour, an ordinary diploma or a certificate, merely stating that the courses of the establishment have been satisfactorily followed during the four years.

Each pupil receives a book in which his marks are entered both for studies and conduct. It is delivered to him every Saturday evening, and must be returned on the following Monday morning at the school, signed by his parents or guardians.

Rewards are given in the shape of books, gravures, tools, or money. Pupils who do well are entered at the end of each "*trimestre*" in an honour list, and those who are thrice entered on such list receive an "honourable mention" at the end of the year.

The

The punishments for bad conduct or insufficient marks are:—

(i) Simple censure; (ii) supplementary work; (iii) detention; (iv) temporary exclusion; (v) permanent dismissal.

The gravity of the same faults is deemed to increase with the years of the course, and a definite scheme is followed. Should any pupil be thrice excluded in the same "*trimestre*" he is permanently dismissed from the school.

8. *Courses for adults, Ecole Estienne.*—Besides the ordinary day courses, there are also courses for adults in the evenings, to enable those already engaged in their callings during the day to perfect themselves. Arrangements can be made for any of the day courses, but at the time of the Commissioners' visit to Paris, the only evening courses actually in operation were those for compositors, printing, stereotyping, lithographic printing, and bookbinding.

9. *Staff of the Ecole Estienne.*—The staff of the school consists of the administrative officers, the teaching staff, the workmen, as follows:—

Administration—
- Director.
- General Superintendent.
- Accountant.
- Chief of Works.
- Medical Instructor.
- Secretary.
- Storeman.
- 5 Supervisors.

Teaching Staff—
- 10 Teachers of theory.
- 24 Teachers of technical practice, of which 14 are titular, and 10 auxiliary.

Workmen—
- 1 Laboratory hand.
- 5 Supernumeraries.
- 1 Cook, with 3 assistants.
- 1 Concierge, domestic service.

The *Director* is the chief officer of the whole establishment, and is charged with the following duties, viz.:—

(1) The pædagogic direction, embracing everything which has to do with the professional studies, discipline, etc.
(2) The administrative direction, embracing the relations with primary education, the Committee of Supervision, the parents, etc., of the pupils, the general public.
(3) The economic direction, supervision of the accounts, and expenditure, etc.

The *General Superintendent* is the assistant, and in case of his absence takes the place of, the Director. He is chief of the supervisors, whom he directs, and aids by his experience He is responsible for the rigorous application of the students, class discipline in study, in the workshop, in recreations, and generally, attends to the management of the school in detail, under the Director.

The Accountant is charged with the financial administration of the establishment, the inventory of the material, the library, school furniture, etc., etc.

The Chief of Works is responsible for the workshops, and for the students' work therein.

The other officers need not be referred to here.

10. *Excursions of pupils, Ecole Estienne.*—Every year the first twelve pupils who are on the point of leaving the school make an excursion lasting from four to six days to printing and publishing and similar establishments, museums, etc., in such cities and towns as Corbeil, Orleans, Tours, Nantes, Angoulême, La Rochelle, Rheims, Nancy, Amiens, Rouen, Le Havre, Lille, Bruges, Antwerp, Brussels, etc. All the pupils periodically visit the great printing, typefounding, lithographic, and similar houses of Paris. The proprietors are particularly good in the trouble they take to make these visits informative, and take care that as far as possible, the technical explanations of the various processes shall be as complete as possible.

11. *Details of the theoretical courses of the Ecole Estienne.*—To get a real understanding of the course of such a school as the Estienne School, it is necessary to briefly review the details of the course. The following will give the necessary conception of its aim and thoroughness, remembering, of course, the conditions of admission.

These details will cover the whole range of the subjects, so as to reveal the thoroughness of the European systems of technical education.

12. *French in the Ecole Estienne.*—The following is the course in French given in the school:—

FRENCH LANGUAGE.

1st Year.

1st Trimester.—General ideas concerning lexicology and syntax, the noun, article, adjective. Oral grammatical analyses of each of these species of words. Logical analyses. Dictation: examples selected from among the histories of the various industries.

2nd Trimester.—General ideas concerning lexicology and syntax, the pronoun, verb, participle. Analyses and dictation as during the first quarter.

3rd Trimester.—General ideas concerning lexicology and syntax, invariable words. Orthographical signs, punctuation, accentuation, etc. Tabulated exercises and application of the preceding rules; selection of examples from the history of special features of printing and publishing.

During the three trimesters there are literary explanation and recitation of selected passages (prose and poetic) and oral exercises in French composition.

2nd Year.

1st Trimester.—Origin and formation of words. Affixes—Study of suffixes and prefixes. Roots. Various exercises. Technical orthography.

2nd Trimester.—Signification of words; literal meaning, derived meaning, figures of speech, synonyms. Families of words; oral and written exercises. Résumés of selections from literature.

3rd Trimester.—Exercises on the difficulties of the French language. General ideas concerning style and literary composition. Short exercises of application.

During

During the three trimesters, explanation and recitation of selected passages (prose and poetic), recapitulation of the principal grammatical rules, dictation of detached phrases, and dictation the text of which will be selected from the history of the principal artists of the various specialties, form features of the instruction, and there is also special reading of Greek for compositors.

3rd Year (for two divisions).

Recapitulation of the general ideas of literary style and composition given in the 2nd year, followed by ideas on the various kinds of literary composition: narration, description, letter, statement. Exercises in application of the preceding. Résumé of the literary history of France from the beginning to the 16th century inclusively. Illustrated literary readings.

During the three trimesters, dictations, the passage of which are taken preferably from the history of the several industries connected with printing and publishing; these are principally for typographers. Typographical grammar, the reading of Greek, and the reading of manuscripts are also features of the work, the last being exclusively for compositors.

4th Year (for two divisions).

Redaction of the various kinds of letters, especially those which pass between "patrons" and workmen, merchants and clients, etc. Redaction of a statement, of an account rendered, of a note of despatch of merchandise, etc. Study of the principal French writers of the 17th, 18th and 19th centuries. Illustrated readings from the best pages of these authors.

During the three trimesters there is also dictation, and the pupils are exercised in typographical grammar, the reading of Greek, and reading of manuscripts. This is, of course, for compositors.

13. *History and Geography in the Ecole Estienne.*—Special attention is directed to the very liberalising effect of such a course as that described hereunder, and to the class of workman likely to be turned out by a school of this type.

HISTORY AND GEOGRAPHY.

1st Year.

General History.

1st Trimester.—Egypt. The Semites: Assyrians, Phœnicians, Jews. Aryans: Medes and Persians. India. China and the Mongols. Greece: its history, its great men, monuments, mythology.
2nd Trimester.—Rome: the royalty, the republic, the empire; letters and arts; decadence and partition of the empire; East and West. The barbarian invasions. The Merovingian Franks. Charlemagne and his successors.
3rd Trimester.—Feudalism. The Crusades. The Communes. Principal historical events of France, England, Germany, Italy, and the Papacy; of Spain and the Scandinavian and Slav countries of the Middle Ages. Invasion of the Turks into Europe. Fall of Constantinople.

Geography.

1st Trimester.—General ideas of cosmography. The planets. The earth in space. Animals and vegetables. Man, governments, religions. Configuration of the earth; globes and maps.
2nd Trimester.—Recapitulation of the geography of Europe. Comparison from the point of view of wealth and power between each of the countries of Europe.
3rd Trimester.—Recapitulation of the physical and political geography of Asia, Africa, America and Oceania. Principal productions of these countries. Colonies of France in each of these countries.

2nd Year.

General History.

1st Trimester.—General history of Europe from 1461 to 1643. Progress of royalty in England, Spain and France. Formation of the nationalities. Inventions and discoveries. The Renaissance and the Reformation. The great political and religious wars of the 16th and 17th century: Italian wars, religious wars, The Thirty Years' War.
2nd Trimester.—General history of Europe during the second half of the 17th century and during the 18th century until the Revolution. France: The triumph of absolute monarchy. England: Definite establishment of the parliamentary *régimé*; foundation of its colonial and maritime power. Decadence of Poland and Sweden. Aggrandisements of Russia and Prussia. The political reforms in Germany, Spain, etc. Letters, arts, and sciences in the 17th and 18th century.
3rd Trimester.—History of France and Europe from 1789 to 1815. Preliminaries of the Revolution. Fall of royalty in France. The Convention, the Directory, Consulate, and Empire; internal dissensions and external wars. Benefits of the Revolution. Europe in 1815; reaction against the principles of the Revolution of 1815 to 1830. The Restoration. Letters, sciences, arts, travels. Europe from 1830 to the present time. The monarchy of July. The Eastern question. The revolution of 1848. The Second Empire. The Franco-German war. The Third Republic. Power of England, Germany, and Russia.

Geography.

1st Trimester.—Agriculture in France. Vegetables and animals. The alimentary and textile industries. Regions of production. Comparison with foreign countries.
2nd Trimester.—Extractive industries: coal, iron, and the principal metals; quarries. The metallurgic industries: the iron industry, machines, arms, etc. Various centres of these industries. Comparison with foreign countries. Importation; exportation.
3rd Trimester.—Building and furniture industries, ceramics, glass, watchmaking, etc. Chemical industries: papers, hides, inks, soaps, wax candles, etc. The highways of France: roads, railways, canals. Recapitulation. Communication with foreign countries, railways, lines of navigation, telegraphic lines, etc.

14. *History of Art and of the Production of Books in the Ecole Estienne.*—The history of the production of manuscript and printed books, their illumination, and their illustration, is intimately associated with the whole history of human civilisation, and with that of art. The Ecole Estienne offers a remarkably comprehensive course for its pupils, to which special attention is directed.

It is worthy of remark that persons who go through such a school enjoy advantages which nothing in Australian technical education approaches. And although it may be impracticable to make technical forms of education here equally thorough until the whole plane of our educational method is raised, the ideals need to be created so as to give us an aim-point for progress.

HISTORY OF ART—HISTORY OF BOOKS.

HISTORY OF ART.

3rd Year.

Influence of the form of the society on the development of art. Influence of industrial material on artistic manifestations.
The Ancient Civilisations.—Egypt, Chaldea, Assyria, Media, Persia, Asia Minor. Geography of these regions; relations between these countries. Phœnician commerce.
Art.—Egypt: decorative painting and sculpture. Western Asia: Lydo-Phrygian art.
Hellenic Civilisation.—Islands, continents, colonies; Hellenism.
Art.—Architecture and orders, sculpture, terra cotta, painted vases, costume. Mythology and its symbolism.

Civilisation

Civilisation in Italy.—Greece Proper, Etruria, Latium, Rome. Era of conquests. Catholicism. Constantine and Theodosa.
Art.—Etruria: tombs and vases. Greek art in Sicily and in Greece Proper. Roman Republic; conquest of Greece; empire; catholicism; Constantine and the two empires. Decorative painting. Costume, arms.
Geography of the frontiers of the Roman Empire; the invasions.
Byzantine Civilisation.—Administration; Justinian. The decadence. Influences. Ravenna.
Art.—Roman, Greek, Arabo-Persian influences. Justinian epoch, Saint Sophia. The mosaics. The iconoclasts. Art in the 12th century.
The Arabians.—Mahomet, the conquests. Various centres of development of Arabian art. Ceramics, ornamental sculpture, tapestry.
Civilisation under the Western Barbarian Kingdoms.—Catholicism. Roman laws of the barbarians. Localisation of the Visigoths, the Ostrogoths, the Burgundians, and Franks. The Merovingians and Carlovingians.
Art after the Invasions.—Convents; rude imitation of Roman, Byzantine, and Arabian models. Relations of the Carlovingian Empire with the neighbouring kingdoms.
Civilisation in the 11th and 12th Centuries.—Feudalism, the Church, Crusades. The provinces.
Roman art.—Sources; various provincial schools. Principles of construction and decoration. Vaults. Symbolism and iconography. Sculpture, Costume, etc.
Civilisation in the 13th and 14th centuries.—Royalty and feudalism; the royal centralisation commences.
Gothic art.—Architecture: pointed arches; pillars and arches, columns, rose-work windows. Decoration: mural painting and on glass, tapestries. Sculpture. Costume and arms.

4th Year.

Civilisation in the 15th and 16th centuries.—The ideas: classical studies, Roman law, the Reformation. The facts: great international wars; France in Italy; absolute monarchy. The Turks in Europe. Venice and the Greek colony.
The Renaissance.—Italy and Germany: architecture, sculpture, painting, engraving, the work of the goldsmith and silversmith. France: The French Renaissance, properly so-called; The Italian wars and second Renaissance; the schools of Fontainebleau and of Lyons.
The Civilisation of the 17th and 18th centuries.—Triumph of France in Europe; and of the absolute monarchy in France. Court of Louis XIV; Regency. Transformation of European political geography Russia, Prussia, Poland.
Art in the 17th and 18th centuries.—Architecture, sculpture, painting, engraving, jewellery. Influence of France in Europe.
The 19th century.—Moral and financial state in 1789. French Revolution, Empire, Restoration. Contemporary epoch. Social transformation; the working class.
Art in the 19th century.—Neo-Grecian style; the Davidic school. Romanticism. Archeology. Attempts toward a new style.

History of Printing and Publishing, etc.

3rd Year.

Writing.

Theory of writing.—Divisions: *ideographic writing* (figurative, symbolic); *phonetic writing* (syllabic, alphabetic).
History of the alphabet, from the time of the Phœnicians until the invasions of the barbarians.
History of the characters, from the Roman epoch to the present time. National, Merovingian, Carlovingian, Roman, Gothic and Renaissance types, as much from the point of view of the origin of the modern types as from a decorative standpoint. Origin of what are known as Gothic, Roman, Italic and Elzevir typographical characters.
Writing materials.—*Various substances.*—Stone, marble, baked earth, metals, bone, wood, wax tablets.
Papyrus.—Its origin. History of its use.
Parchment.—Its origin. Its manufacture. Its usage in antiquity, the middle ages, and in modern times.
Paper.—Its origin, history, its manufacture by hand, and by machinery. Various pulps. Water marks, etc. Centres of production.
Writing instruments.—Inks, pens.

Execution and Decoration of Manuscript Books.

(1). *Manuscript Books, their execution.*—Execution of manuscripts in antiquity: slaves and their emancipation; caligraphists. Execution of manuscripts in the Middle Ages: the Monks until the 13th century; lay transcribers; the Corporations and the Universities; book-sellers; libraries and amateurs; lending-libraries and location. Manuscript in modern times; decorative letters.
(2). *Manuscript Books, their internal decoration.*—Illustration in antiquity. Illustration in the Middle Ages. *Origins of illumination*: The Roman, Byzantine and Irish elements. *Great periods*: Barbarian period; Roman or hieratic, Gothic or realistic periods. The schools of illumination. Modern illumination.
3. *Manuscript Books, their external decoration.*—Preservation of books in antiquity. The later Roman bindings. Binding in the Middle Ages; gold, or silver, ivory, cloth, and skin, or leathers. Monastic bindings.

4th Year.

Execution and Decoration of Printed Books.

(1.) *Printed Books—their Execution.*

Period of Transition.—Cut-out patterns; stamping. Xylography; pictures without text and playing cards; illustrations with text; text without illustrations. Characteristics of xylographers.
Examination of Typographical Processes.—Lourens Janszoon Coster, Waldvogel, Johann Mentelin, Gutenberg.
Invention of Typography.—Gutenberg, Fust, Schoeffer.
Spread of Typography.—The episcopal revolution of Mayence. Printing in Germany: Zell and Koburger. In Italy: Pannartz, Sweynheim, Jenson, the Alde, Bodini. In the United Provinces: Plantin, the Elzevirs. In England: Caxton, Baskerville, Pynson.
Typography in France.—Printing in Paris: Fichet and Jean Heynlin, Géring, Crantz, Friburger, the Estiennes. The principal Parisian printers. Printing in the provinces.
The Incunabula.—General characters.
The Typographic industry.—History of the characters of composition, of the press. Pagination, signatures, réclames. Stereotyping. Working in colour.

(2.) *Printed Books—their Internal Decoration.*

Xylographical pictures, manual processes.—History of the various kinds of engraving and lithography.
Processes properly so-called.—History of the mechanical, chemical, and heliographic engraving. Zincography, phototypy, *similigravure, heliogravure*, photolithography.
Illustration in colour.—Working in several colours. Chromolithograpy and photochromolithography. *Similigravure* in three colours.
History of illustration, principally in France, from the 15th century to the present time.—A. Durer, Marc-Antione, Raimondi, Holbein. The French school: Simon Vostre, Kerver, Pigouchet, G.Tory, the Audrans, Edelink, Eisen, the Moreau. The David school. Lithography: A. Senefelder, the Vernets, Charlet, Raffet, Daumier, Gavarni.

(3.) *Printed Books—their External Decoration.*

15th Century.—The monastic binding.
16th Century.—Italian bindings: Majoli, the Aldes, Canevarius. French bindings: Grolier, the Eves, de Thou. Divisions and flourishes.
17th Century.—Tools, punches, etc.: Gascon, Florimond Badier.
18th Century.—Typographical tools. Various forms of work. Mosaic, Derôme, the Pasdeloups, Duseuil.
19th Century.—The Empire and the Restoration. The Neo-Greek style. Romanticism and the fers cathédrale. Thouvenin. Archeological researches. Renaissance attempts. Floral decoration.

During the 4th year visits are made to the National Library. Besides what is thus seen, specimens and examples are shewn during the course, so as to familiarise the pupils with the most notable types of printing, illustration, and binding.

15.

15. *Mathematics and Accountancy, Ecole Estienne*—The following are the subjects treated under the heading of mathematics and bookkeeping. They are broadly taken, and yet are practical in the highest degree:—

MATHEMATICS AND ACCOUNTANCY.

1st Year.

Arithmetic.—Whole numbers. Numeration. Operations. Divisibility. Prime numbers. The greatest common divisor, The least common multiple.
Fractions.—Properties. Operations. Decimal fractions.
Metric System, Practical Problems.—Proportion, interest, discount, exchange, shares, partnerships, mixtures, allegation.
Applications to Typography.—Measures for paper. Sizes. Exercises.
Plane Geometry.—Elementary ideas. Definitions. Text Books I, II, and III. Measurement of areas.

2nd Year.

Arithmetic.—Recapitulation of practical problems. Square root. Cube root, practical method of extracting.
Geometry, Plane Geometry.—Text Book III (conclusion) and Book IV.
Spatial Geometry.—General ideas concerning the plane and its properties. Measuremont of the volumes of polyhedrons. Measurement of the volumes of round bodies. Exercises.
Algebra.—Ideas of practical algebra. Operations. Fractions. Equations of the 1st degree to one or two unknowns. Problems. Exercises.

3rd Year.

Arithmetic.—Recapitulation of the problems of interest, discount, etc.
Geometry.—Application of geometry to the section of fillets, etc.
Accountancy.—General accountancy.
Bookkeeping.—Single and double entry. Waste book. Day book. Ledger. Practical bookkeeping by double entry.
Accounts-current.—Various methods for the calculation of interest, for the keeping of current accounts, etc.

16. *Natural and Physical Science, Mechanics, Ecole Estienne.*—The practical educationist will naturally be interested as to what is thought necessary for the technical education of printers and publishers in other countries of the world in the way of science instruction, so much neglected in our State; hence an outline of the courses in physics, chemistry, natural history, etc., is given.

PHYSICAL AND NATURAL SCIENCES, MECHANICS.

1st Year.

Physics.

Heat.—Dilatation of bodies. Temperature. Thermometer. Applications of dilatations. The definition of the caloric and specific heat. Conceptions concerning change of state. Fusion. Solution. Solidification. Ebullition. Evaporation. Ideas concerning radiant heat and conduction. Practical applications.
Optics.—Rectilinear propagation of light in a homogeneous medium. Reflection and refraction of light. Deviation produced by a prism on the direction of a ray of homogeneous light. Properties of lenses. Dispersion of light. Colours of bodies. Ideas concerning photography.
Acoustics.—Production, propagation and reflexion of sound. Echo.
Weight.—Direction of gravity. Plumb-line. Pendulum. Balance.

Chemistry.

Preliminary Ideas.—Simple and compound bodies. Distinction between mixture and combination. Atmospheric air. Oxygen. Nitrogen. Combustion. Water. Hydrogen. Chemical nomenclature. Exercises. Conceptions as to the principal oxygen compounds of nitrogen, in particular of nitric acid. Ammonia. Phosphorus. Phosphates. Sulphur. Sulphurous, sulphuric acid, hydrosulphuric acid. Fluorine, bromide and iodine. Carbon, natural and artificial. Carbonic acid and carbon mon-oxide. Silica and the principal silicates.

Natural History.

Zoology.—The structure of man. Digestion. Circulation, respiration, secretions. Functions of relation. The osseous system. Muscular system. Nervous system. Sense organs. Leading lines of zoological classification. Vertebrates. Invertebrates.
Conception of Hygiene.—General. Alcoholism.

2nd Year.

Physics.

Hydrostatics.—Liquids at rest. Experiments demonstrating their principal properties; and the pressures which they exert. The principle of Archimedes, applications of same. Gas. Atmospheric pressure. Barometer. Mariotte's law. Manometer. Pumps. Syphon.
Elementary notion of Force and Work.—Transformation of heat into work, and *vice versa*. Steam engine.
Static Electricity.—Production by friction, by influence. Power of points. Electroscope. Leyden jar. Atmospheric electricity. Magnetism. Notion of magnets.
Dynamic Electricity.—Principle of the cell. Electric current. Electric resistance. Electric lighting. Galvanoplastic work. Action of a current upon a magnet. The galvanometer and its use. Principles of telegraphy. Idea of induction, application to the efficient working of induction machines. Telephone.

Chemistry.

Properties and Classification of Metals.—Alloys. Potash and soda of commerce. Application to washing. Nitrates of potassium and sodium. Nitrification and application. Marine salt. Rock salt. Hyposulphite of sodium. Cyanide of potassium. Chalk. Mortars. Cement. Glass-making establishments, potteries. Alums.
Ordinary Metals and their production.—Those of importance to printers, typographers, etc., are specially treated.
Organic Chemistry.—Principal carbides of hydrogen. Ordinary alcohol. The commonest organic acids. Fatty bodies. Papers and inks.

Natural History.

Botany.—The organs of a plant and their functions. Root, stem, leaf, flower, fruit, seed. Various modes of multiplying the plant. Classification of plants. Study of several great families.
Mineralogy and Geology.—Characters of minerals. The most important from the standpoint of industry. Study of several rocks. Action of water. Glaciers. Internal heat. Earthquakes. Volcanoes. Earths of igneous and sedimentary origin.
Hygiene.—Alcoholism.

3rd Year (one Division only).

Artistic Anatomy.—Osteology and general. Nomenclature. Vertebral column. Skeleton, trunk, sternum, ribs. The thorax as a whole. Skeleton of the shoulder. Clavicle. Omoplate (scapula). Head of humerus. Articulations of the shoulder. Humerus and articulations of the elbow. Skeleton of the fore-arm, radius and cubitus (ulna). Movements of pronation and suppuration. Skeleton of the hand. Proportions of the superior member. Brachial index. Egyptian canon. Skeleton of the hips. The pelvis. The *os iliacum* and *sacrum*. The pelvis in the two sexes. The femur and articulation of the hip. Proportions of the hip and shoulders. The femur and the articulation of the knee. Model of the region of the knee. Skeleton of the lower part of the leg. The tibia and peronæus (fibula), malleolus. Skeleton of the foot. Proportions of the lower member. The foot as a popular measure. Skeleton of the head. Facial angle of Camper. Conceptions of comparative osteology.

4th

4th Year (one Division only).

Myology.—Muscles in general. Muscles of the anterior region of the trunk. Great pectoral, oblique, and right abdominal muscles. Muscles of the back. The trapezius—the great dorsal muscles. Muscles of the shoulder, of the arms. Form of the arm. Muscles of the forearm. Anterior muscles. External, internal, and posterior superficial muscles. Deeper posterior muscles of the forearm. Anatomic *tabatière*. Muscles of the hand, of the pelvis, thigh, leg, foot, neck, head, of mastication, of expression. Of the possible and impossible associations in regard to the contractions of the facial muscles.

3rd and 4th Years (different Division from the preceding).

3rd Year.—Technology.

Industrial Mechanics.—Various motions utilised in husbandry. Forces and their composition. Centre of gravity. Centrifugal force and its applications. Work, and its measure. Kinetic forms of energy, applications. General considerations as regards simple machines. Pulleys and funicular machines. Spur-wheels, gearing, levers, wheel and axle, inclined plane. Screw. Excentrics. Notions of the mechanics of liquids and gases. Transformation of heat into work, and *vice versâ*. The steam-engine.

Industrial Electricity.—The cell and electric current. Resistance. Electrolysis. Galvanoplastics. Electric lighting. The galvanometer and its use. Induction and induction machines. Transportation of energy to a distance. Telegraphs and telephones.

Industrial Chemistry.—Nitric acid. Etching by acids. Ammonia and its uses. Sulphuric acid and its uses. Chlorine, and its application in bleaching paper pulp. Hydrochloric acid. Natural and artificial forms of carbon used in printing and publishing industries. The potash and soda of commerce. Calcium carbonate. Lithographic stones and their use. The metals ordinarily employed in the publishing industry. Alloys and their uses. *Chemical and physical laboratory work*, as applied to such industry.

4th Year.—Technology.

Optics.—Umbra and penumbra. Reflexion of light, plane and spherical mirrors. Refraction of light. Deviation produced by a prism in a single ray. Principal properties of spherical lenses. Optical instruments. Dispersion of light. The colour of bodies. Notions of photography and its applications to printing, etc.

Industrial Chemistry.—Principal carbides of hydrogen ; their use. Alcohols. Varnishes. Fatty ethers—application. Dextrin. Starch. Cellulose. Paper. The commonest organic acids. Gallic and tannic acids. The tanning of skins, hides. Ordinary inks. Printing inks. Colouring matters. *Laboratory practice* relates to inks, varnishes, colouring matters.

3rd and 4th Year (a third Division).

3rd Year.—Technology.

Industrial Mechanics.—(Same as the preceding course, in the same subject.)

Industrial Chemistry.—(Same as the course just above given, starting with nitric acid.)

4th Year.—Technology.

(i) *Industrial electricity;* (ii) *Optics;* (iii) *Industrial chemistry;* (iv) *Laboratory practice.* (These are all treated as mentioned above.)

17. *Art Drawing, Ecole Estienne.*—The art drawing extends throughout the four years, and is arranged as hereunder. It is an exceedingly well-developed course.

1st Year.

1*st Trimester.*—Study of the art of different epochs. Drawing of ornaments from plaster casts. (French Renaissance, Greek, Roman, and existing epochs.) Sketches of common objects. The ideas of practical perspective.

2*nd Trimester.*—Busts, antique and Renaissance. Still life (various objects). Sketches. Study of draperies from statues, and from a mannikin draped. Sketches of interiors. Feet and hands. Fragments.

3*rd Trimester.*—Flowers, from Nature. Decorative arrangements and compositions (flowers, still life, draperies, various objects). Complete studies from the antique, and the statuary of the Renaissance. Drawing from memory.

2nd Year.

1*st Trimester.*—Study of Byzantine art ; of Gothic and Roman art. Ornaments from models, adapted to the requirements of each division of the school. Busts (Antique, Renaissance, Roman, Gothic.) Feet, hands, and fragments, etc.

2*nd Trimester.*—Study of the Renaissance in various countries (France, Italy, etc.) Drawing copied from selected models, adapted to each branch (*e.g.*, printer, copper-plate engraver, etc.) It is held to be necessary that a workman should be able to copy a drawing given him by an editor. Busts, French and Italian Renaissance. Complete studies (Antique, Michelangelo, etc.) Drawing from memory.

3*rd Trimester.*—Study of the Louis XIII Louis XIV epochs, etc. Ornaments from good models of various epochs. Flowers from Nature. Decorative arrangements (flowers, still life, draperies, various objects.) Drawing from memory.

3rd Year.

1*st Trimester.*—Living model (heads). Renaissance busts. Complete figures. Greek and Roman epochs. Ornaments in various styles, plaster, and copies. Sketches of interiors—practical perspective.

2*nd Trimester.*—Heads with various expressions, from living model. Antique and Renaissance busts. Draped figures. Draped mannikin. Ornaments of various styles. Drawing from memory.

3*rd Trimester.*—Flowers from Nature. Busts and complete figures. Decorative figures of various kinds. Compositions from living plants.

4th Year.

1*st Trimester.*—Figures from Nature. Antique and Renaissance figures. Ornaments of various styles. Study of animals from good models. Drawing from memory.

2*nd Trimester.*—Figures from Nature. Figures of various epochs. Greek, Roman, Renaissance, and up to the present time. Study of draperies. Ornaments of various styles. Modern costume.

3*rd Trimester.*—Figures from Nature. Portraits. Figures from plaster casts. Flowers from Nature. Arrangement of living plants. Drawing from memory.

18. *Modelling, Ecole Estienne.*—The modelling courses extend throughout the four years. The work is graduated as follows:—

1st Year.

1*st and* 2*nd Trimesters.*—Manipulation. Study of elementary *Motifs*, from Nature (*e.g.*, leaf of plane-tree, ivy, oak, rose, vine).

3*rd Trimester.*—Study of elementary ornaments.

2nd Year.

1*st and* 2*nd Trimesters.*—Study of ornamental *Motifs*, selected indifferently from among the following epochs, viz., Antiquity, the Middle Ages, Modern Times, but all having a bold character.

These studies are specially intended to give the pupil the sentiment of difference of plan and depth, etc., and, consequently, of form. Similarly in regard to the human figure. The first studies are preferably upon the head of a bold model, as, for example, may be seen in the column of Trajan.

3*rd Trimester.*—The pupil executes ornaments or figures of less striking relief than heretofore, so as to arrive progressively at the power of producing an impression of immateriality by a very flat relief, as is often necessary in an industrial adaptation—for example, in leather, metal, in binding books or albums, in repoussé work.

3rd

3rd Year.

1st and 2nd Trimester.—The natural acanthus, and the forms of acanthus sculptured by the Greeks, Romans, etc., and up to the present day.

3rd Trimester.—Study of the principal proportions of the human figure. Interpretation and conventionalising forms derived from living plants. The rounded form intersected in bas-relief. Grouping of various elements, ornaments, figures, plants, animals, with the object of developing the sense of arrangement and composition, and that of sculptural colouration.

4th Year.

During the fourth year, the study from the living model is undertaken, also of the great works from antiquity to the the present time, with a view of bringing into prominence the essential features of each.

Execution of modelling in the form of the medallion, etc.

Throughout the fourth-year course, the teacher insists strongly upon the matter of what is known as sculptural colouration, referred to in the third-year course, and he demonstrates that it is the consequence of different convexities and concavities.

By way of assisting the students in the several works studied, the instructor shews the rules of art, which the great art epochs have established. He is specially careful to treat those which can furnish *motifs* susceptible of combination with elements borrowed directly from Nature, thus facilitating the tendency to a new art.

Pupils execute by preference such designs, etc., as are more specially valuable to them for their specialities, and the instructor charges himself with encouraging and developing the personality and characteristic style of each pupil, for it is held that this is a rational means of reaching sincerity of sentiment, of truth in interpretation in all productions—industrial or otherwise, in which Art is the essential element.

19. *Decorative Composition, Ecole Estienne*—Decorative composition in connection with publishing is subject to certain limitations, while it is at the same time based on the foundation common to all forms of decorative composition—that is, to the general theory of the art of drawing. The courses are common for the 1st and 2nd year, but are varied for three different divisions in the third and fourth years.

1st Year. Science and Art of Drawing Outline—form, style, conception, colour, image.

1st Trimester.—Descriptive initiation. Denominations and dispositions. Essential features of application to printing, etc. Linear elements. Outline. Mathematical theory. Point, line, angle, rectilinear and curvilinear surfaces.

2nd Trimester.—Surfaces. Polygonal constructions. Ornamental applications. Various fillets, etc. Attempts at vignettes, etc.

3rd Trimester.—Bodies, volumes, geometrical theory of the aspects of a solid. Dihedral angles. Polyhedrons. Projections. Perspective of observation. Various objects. Theoretical applications in grouping. Architectonic notions. Mouldings, etc. Profiles and sections. Apparatus and rudiments of construction. Plans, elevation, physical raising. Objects of simple furniture, section, and assembling.

Each part of the course is made the object of special demonstrations.

2nd Year. Art and Ornamental science. Perception of style, descriptive theory, composition, synthesis, æsthetics.

1st Trimester.—Art in various civilisations. Documentary elements of primitive times. Ideas of arrangement. Characteristics according to document. Legendary and literary sense.

Ancient epoch. Hieratic art. The Egyptians symbolic interpretations. Hieroglyphic attributes. Adaptation and application to modern decoration of the page or book. Sketches, etc.

2nd Trimester.—Chaldeo-Assyrian and Babylonian Art. The Medes, Persians, and Jews. Analysis and style of documents. Adaptation and application. Sketches, etc. Illustration of *demi-luxe.*

3rd Trimester.—The Phœnicians. Archaic epoch. The Hellenes. Analysis and style of various artistic manifestations. Adaptation of legends to modern art. Illustration of *demi-luxe.*

3rd Year (one division). General or Theoretical Instruction. Decorative Style and Composition.

1st Trimester.—History of art and of ancient and modern civilisations. The Greeks. The age of Pericles. The Etruscans. The Romans. The Gallo-Romans. Analytic adaptation to modern art in relation to publishing.

2nd Trimester.—Byzantine and Arabo-Moorish epochs. Frank and Carlovingian epochs. Archaic French art, 11th to 13th century. Writings, heraldic art, the middle ages.

3rd Trimester.—Epoch 13th to 15th century. French Renaissance, and essay on foreign forms. Present-day adaptations to publishing industries.

4th Year.

1st Trimester.—Modern epoch. Renaissance, 17th century. Epochs of Henri IV, Louis XIII, Louis XIV. Analytic adaptation to modern art. Illustration *de luxe.*

2nd Trimester.—18th century. Epochs of Louis XV and XVI. Republic, etc.

3rd Trimester.—Semi-modern and contemporaneous epochs. The Directory. The Empire. Romanticism. Fantastic Art. General revision of course.

3rd and 4th Years (same Division as preceding)—Practical Instruction.—This comprises instruction in engraving relief upon metals, gilding upon leather, etc. The same upon stone, on wood, lithographic writing, and drawing.

3rd and 4th Years (Second Division).—This section is devoted to fantastic or conventional and composite drawing.

3rd and 4th Years (Third Division).—*Linear Drawing* applied to the theory and drawing of forms, to the question of scales, proportions, sketches, plans, elevations, the delineation of the organs of a piece of machinery used in printing, etc.

20. *Perspective, Ecole Estienne.*—This course is taken in the fourth year by one division only. It is divided into two parts, theoretical and practical.

First Elements of Theoretical Perspective.—Picture line of the horizon, distance points, vanishing points. Perspective of a square on a horizontal plane, of a cylinder, etc. Regular hexagon inscribed in a circumference. Equal division of straight lines in a horizontal plane. Study of middle distance (distance-point inaccessible). Perspective of a straight line of steps, the treads being parallel to picture. Perspective of arcades, etc. Magnitude of figures on a landscape, the spectator being variously circumstanced.

Practical Perspective. Vanishing point inaccessible (scale of reduction).—The shadows of a cube on a horizontal plane, the sun being in the picture plane, or before or behind the spectator. Accidental vanishing points. Perspective of reflections in water. Perspective of the shadows of objects illuminated by artificial light.

The above course, it is evident, is sufficient to give an artist the fundamental conceptions of perspective, but cannot, of course, be regarded as in any sense complete.

21.

21. *Photographic Chemistry and Physics, Ecole Estienne.*—This course is designed for young pupils in photography, who intend to be engaged in the photo-mechanical industries. It affords them that knowledge of the application of physics and chemistry to their work, which, while specially useful to them, would not be so to the mass of the pupils generally.

It is arranged about as explained hereunder.

1st and 2nd Years.—The instructor gives first a recapitulation of the properties of matter which are of special moment in photography. He then describes the various processes with negatives and positives, collodion, gelatine, sensitised papers, etc. The pupils familiarise themselves with the names of the various substances used, take note of the most important formulæ, and observe the chemical reactions upon which the various processes depend.

3rd and 4th Year.—Certain parts of other courses are more highly developed—for example, the laws of lenses, and of lens-systems are treated in relation to the needs of photography, the "*halo photographique,*" the function of diaphragms is explained, the screen in "*similigravure*" and so on.

The study of chemical reactions is further advanced, and the theory of the principal formulæ employed in orthochromatic work.

The pupils also are instructed as to the management of arc lamps, dynamos, and similar matters.

22. *Miscellaneous subjects, Ecole Estienne.*—In *Caligraphy*, to which two years are devoted, attention is paid to the position of the body, the mode of holding the pen, and English writing from good models is practised during the first year.

During the second year the writing practised is English, round, bâtarde, commercial, and is applied to the arrangement of tables, headings of bills, etc., etc.

The programme in *Gymnastics* is that of the primary schools, and must conform to the ministerial regulations.

The technical courses are as follows hereinafter.

23. *Technical Courses in the Ecole Estienne—Type-founding.*—The general aim is of course to make skilful type-founders. The importance of type-founding increases every year; the demand continually and rapidly growing, and great improvements in type-founding machinery have made the production much more rapid and less costly. The work during the several years is as hereunder:—

1st Year.—General notions of type-founding, various alloys, and substances needed, study of simple type-founding machines. The cutting and polishing of the copper for the matrices. Elementary theory of the "*point typographique,*" description, explanation of the tools, etc.

To accustom the pupils gradually to the heat of the foundry they take turn at various founding operations.

In studying the machines, they study the function of its various parts, learn how to take it to pieces and put it together again. They also learn to discern the qualities of well founded type.

2nd Year.—Practical demonstration of founding in the simple and in the universal machine. Exercises in composing, and justifying, cutting and polishing the copper for the matrices. Recapitulation of the work of the preceding year.

3rd Year.—The work is of the same type with increasing difficulty.

4th Year.—During the last year the pupils take all the difficult practical exercises of their calling with hand and machine moulds, and are practised in the justification of matrices of all kinds.

24. *Composing, Ecole Estienne.*—The courses in the work of the typographical compositor last four years, and aim not only at making ordinarily equipped compositors, but also workmen capable of raising the level of the typographers' art. To reach this end the pupils execute every kind of work progressively, without specialising in any one kind.

The whole idea is to make good practical workmen, not merely overseers; and though many of the old pupils attain to positions something above that of ordinary workmen, it is by practical merit and personal worth. The progress of the work is roughly as follows:—

1st Year.—Study of the "case" or fount, use of apparatus; the material and the type. The pupil first sets up simple lines from print, then from manuscript; then broken lines, etc. They learn the principal typographical rules concerning lifting, spacing, justification, divisions, use of capitals and italics, correction, and so on.

2nd Year.—The work is a continuation of the preceding, the progress always being adjusted to the skill displayed. Practice to develope skill and cleanliness in composing. The taking to pieces, cleaning, and resetting the various tools, pieces of apparatus, etc, are learnt.

3rd Year.—Previous work with increased difficulty. Setting Greek, algebra, and similarly difficult work. Work with foot-presses.

4th Year.—More advanced work by way of completion. There is in connection with this course one of typographical correction, and reading of Greek. The instructor, after correcting the errors of the pupils, explains their faults, the errors of punctuation, etc. Not only are typographical faults corrected, but grammatical errors and bad French construction are dealt with, and the course then becomes to some extent a continuation of the lesson in French grammar.

The pupils are thus prepared for the most important work they would be called upon to carry out in printing houses, where authors and readers need to be seconded in their efforts by experienced and skilful correctors, who will not let any of those wrong letters (*coquilles*) escape them, which are the despair of exact writers and conscientious printers.

25. *Stereotyping and Galvanoplastics, Ecole Estienne.*—The growing importance of stereotyping, and of photographic process illustrations, is obvious. The four years' course developed for the above is in response thereto.

1st Year.—Theoretical and practical introduction to the whole range of the work.

2nd Year.—The pupil is familiarised with the apparatus, machines, tools, material; learns the composition of alloys used, the making of the blocks.

3rd Year.—Previous work more advanced. Galvanoplastic processes; reproduction in wax and guttapercha. Reproduction of vignettes, gravures of all kinds. Pupils learn the functions of the electric apparatus in the school—cells, dynamo, accumulators, etc.

4th Year.—Work in all branches, with special attention to all the more difficult matters. The pupils' attention is strongly drawn to the necessity for perfect work, and rapid and certain production. He is taught the significance of imperfect work to the printer.

26. *Printing, Ecole Estienne.*—The modern printer must be thoroughly familiar with hand-presses, as well as other forms of printing machines. No part of the work is allowed to be neglected;—for example, pulls of "photo.-work," "galvanos," work in colour, etc.

1st Year.—The student becomes familiar with the nomenclature of the various parts, and their function, of the printing press. Then he learns the composition and use of rollers, of printing inks, etc., and the process of manufacture of printing inks, and also the operations preparatory to the various kinds of printing.

2nd

2nd Year.—In the second year the pupils learn the use of hand-presses, and do printing with octavo and duodecimo registers, and pulls of simple work in colours. They receive also elementary ideas of various kinds of "gravures."

3rd Year.—The work of the third year is more advanced. Less simple registers and work in colours are taken in hand. Photochrome work, or three-colour process, is commenced. The more difficult forms of printing generally are also undertaken.

4th Year.—The work in the fourth year commences with a recapitulation of that of the preceding years. Then the most difficult work is undertaken. While this is proceeding the pupils of the second and third years assist in oiling and cleaning the machines, and thus become familiar with them.

27. *Lithographic Drawing, Ecole Estienne.*—The instruction in this subject comprises three sections of work, viz., work with ink, with the pencil, chromo-photo-lithography. The course is four years. The fundamental work is that in ink, and this extends throughout the course. The work with the pencil is taught, but the profound modification introduced by photography is necessarily recognised. Nevertheless instruction with the pencil is indispensable to the lithographer, and is of great use in the chromograph. By its use, even with one colour and with one printing, quite a range of *nuances* are possible. The instructor is careful to seize every opportunity of developing the æsthetic judgment of the pupil, and he endeavours to make the courses in the school react against any treatment of industrial art as if it were inferior to art in the more abstract sense of the term.[1]

1st Year.—Mode of cutting lithographic pencils, of converting steel bands into pens. Study of the calque. Various methods of transfer to stone. Execution on stone of simple models for the purpose of initiating the pupil into the use of the lithographic pen and the grease pencil. Necessity for habits of order and cleanliness to secure good results. Handling the stones. Mode of safeguarding against accident. Exercises with lithographic pen and pencil. Geometrical exercises involving use of compass and ruler. These studies are made progressively difficult. Copy of engravings, etc.

2nd Year.—Exercises in imitative drawing suitable for lithographic execution. Work with the lithographic pen. Landscapes, ornaments, figures, exercises on the stone from models so graduated as to compel the pupil to surmount successive difficulties in execution, and with the pen increasing the difficulty. Shadows by *hachures* exercises in drawing from nature, introducing practical deductions as to the phænomena of perspective and light effects. Copies of simple engravings, exercises in *pointillé (genre Jehenne)*, exercises with lithographic pencil as applicable to chromo-lithography. First attempt at colour combination. Interpretation of sketches, photographs, oil paintings, water-colour paintings, work in distemper, pastels, etc., by work with the lithographic pen *(pointille and etching)*, by shade, and the lithographic pencil.

3rd Year.—Execution on the stone of subjects presenting difficulties of modelling or effect. Continuation of exercises of preceding year. Artistic anatomy. Ornamental composition. General laws governing *motifs* and subjects, treated from the decorative point of view. The applications of geometry to drawing, descriptive geometry, projection, perspective, etc. The object of this work is to enable pupils to draw to any desired scale industrial objects, which one may wish for example to figure in an album or an industrial catalogue. Study of combinations of colour. Autography, geometry, machines, figures, and ornaments. Exercises on the use of the eraser, and on the use of varnish on the stone. Shading in order to heighten the light effect. Drawing of industrial objects from nature, plan, elevation, section, perspective. These drawings are transferred to the stone, or to the zinc and are lithographed by means of etching, *pointillé*, the pencil, etc. Chromolithography, study of the combination of colours. Copies of the fine engravings of the 16th and 17th centuries. General interpretation by means of the lithographic pen, of photographs, paintings, drawings, etc.

4th Year.—The work of the preceding years is advanced in the 4th year, and the independent studies are united so as to call into exercise the range of manipulative skill already acquired. Zincography: Various features of zincography, work upon grained and pumiced zinc. General recommendations as to work on zinc. Chromolithography, chromo-typography. The execution of pictures and subjects by each process. Ornate letters for commercial work. Type of work suitable for industrial albums, catalogues, etc. Views of industrial establishments in black and in colour. The above work is done in each different style, and an endeavour is made to secure that boldness and thoroughness of treatment without which a good and free impression cannot be obtained. Study of the combination of colours. Analysis of pictures in pastels, water-colours, oils, distemper, camaieu, sepia, ceramics, etc. Drawing from nature of industrial objects and interpretation on stone by various methods. General recapitulation.

28. *Stone Engraving, Ecole Estienne.*—The object of the teaching of this subject is to facilitate the production of drawings, illustrations, etc., for commerce, science, etc. (for example, bill-heads, addresses, catalogues, views, architecture, plans, geographical and topographical charts, demonstrative figures, etc.).

1st Year.—Charts simple, English lettering, vignettes, conventional signs in topography, various forms of writing, industrial drawing. The exercises are varied in such a manner that the pupil shall have as far as possible a general aperçu of his calling.

2nd Year.—Plans to the scale of 1 and 5,000 to 1 in 10,000. Towns, rivers, limits, roads, frontiers, English writing, ornaments in Greek style. Map of part of the State: fortifications, railroads, bridges, etc. Italic and round writing, ornaments in Roman style, vignettes. Maps shewing rivers with two banks and various conventional signs, Gothic and Roman writing, Gothic ornaments, maps with Roman and Italic letters, classic characters, mechanical plans, complicated vignettes, Renaissance ornaments.

3rd Year.—Bâton and Egyptian characters. Complete map. English circulars. Mechanical drawing in perspective, application of shadows, vignettes and ornaments of Louis XIV and Louis XV. Sketches from manuscript, bill-heads, business cards, visiting cards, labels, registers, circulars in bâtarde, topographical maps, engraving of industrial objects to scale from sketches and from nature. Conventional topographical signs, titles and various characters, ornamental and fantastic letters, monograms, etc., etc. Complicated industrial objects. Ornamental objects from various industries, copper, glass, etc., from nature.

4th Year.—Mountains on a large scale, complete map. Medal engraving. Elaborate bill-heads and vignettes. Various views of industrial establishments, landscapes, animals. Arrangements of various *motifs*, elaborate bill-heads and cards. Industrial engraving of increasing complexity. Complete engraving of a topographical map. Frontispieces. Engraving of scientifical, botanical and zoological drawings. Engraving of diplomas. Views with figures, landscapes and animals. The use of nitric acid on stone and zinc.

29. *Lithographic Writing, Ecole Estienne.*—The end of this course is a technical study of lithographic work on the stone and with the pen, of writing in vignettes and their various applications, commercial, industrial and artistic. The technique of the pen demands of the pupil a considerable amount of skill in drawing, of its importance nothing need be said.

1st Year.—Use of rule and square. Drawing on the stone of English and round characters in capitals and small letters with the aid of the lead pencil, executed in lithographic ink, using Brandauer's or Mitchell's pens. Precautions to be taken in the use of greasy inks.

2nd Year.—Drawing of characters of all kinds. Use of the drawing-pen. Calque, its various applications, transfer to the stone. Practical exercises with the steel point; outlined drawing from models, cutting a lithographic pen.

3rd

---

1. In the words of the declared object of this branch of the instruction, *"le but de l'école étant de réagir contre l'erreur qui consiste à tenir pour inférieur l'art dit industriel et à le séparer de l'art pris dans son acception absolue."*

3rd Year.—Ornamental characters, white letters shaded with fillets, Register, Mountings and grey lines; various works executed in ink. Shadows interpreted by the lithographic pen, drawing from models. Combination of letters and vignettes. Coloured labels.

4th Year.—Recapitulation and development, using more complex models. Elaborate labels. Titles for music, pictorial advertisements in several colours, brushwork, interpretation of photographs by means of lithographic pen. Various compositions.

30. *Autography, Ecole Estienne.*—The course in Autography is a complimentary one for lithographic pupils. In this course the pupil not only learns to transfer, he also learns to make the original drawings himself. In such drawing he is compelled to understand the subject-matter, for example, if it be architecture, he must understand construction, in order that he may deal with questions of light and shade from description. Similarly in mechanical matters, he cannot make a satisfactory drawing of a machine unless by means of conventional lines, he can represent its many parts and details. Or again, to deal with geographical maps, he must understand something of typography. The course is usually followed by four or five series of lithographic pupils of the second and third year. It consists of about eighteen lessons.

31. *Lithographic Printing, Ecole Estienne.*—The course in lithographic printing lasts four years. The first year is devoted to such matters as the graining of the stone, the study of material, the printing of easier class of work, in black and in colour. In the second year the printing is more elaborate and includes shaded work. In the third year the manipulation of colours is learnt, the combinations necessary for the formation of various tones. Varnishes are studied; the production of chromos with any number of colours, and the mode of printing with various machines. In the fourth and last year, the exercises have for their object the training of the pupils to do their work very quickly and to do it well and the work is advanced to the highest point.

32. *Wood Engraving, Ecole Estienne.*—The course in wood engraving is also a four-year course. In the first year the drawing refers to common objects, copies, and plaster casts. The engraving includes representation of different depths of shading and outline drawing. In the second year there is drawing of bas-reliefs, copying, and drawing from nature plants, materials, drapings, etc. The engraving is *fac-simile* and shading, and oil-paintings, sculpture, pastels, water-colours, etc., are represented on the wood. In the third and fourth years, the programme is simply more elaborate. Drawing is done from memory, pictures are interpreted and engraved by the pupil, and he is advanced to the highest point possible to him in his work.

33. *Relief Engraving, Ecole Estienne.*—Relief engraving includes typographical engraving, and the engraving of gilding irons. The general aim of the course is to educate those workmen whose business it will be to engrave in relief on all metals required in the graphic arts.

Considerable importance is attached to this work, and it is explicitly declared that the instruction specially endeavours to raise the intellectual and artistic level of the pupils. It aims not merely at developing their specialty, but their craft as a whole, and is opposed to that mere specialisation which is believed to be one of the causes of decadence. Recent progress in the graphic arts demands of engravers greater subtlety of interpretation than heretofore, and this can be attained only by a more complete knowledge of their calling. It is recognised also, that the engraver must take account of the general progress of science. For example, steel engraving, a tedious and costly process is already replaced by typography on copper or on type-metal, the necessary matrices being formed by galvanoplastic processes.

The instruction deals with (i) typographical engraving in steel; (ii) on copper; (iii) on gilding irons; (iv) professional drawing, etc.; (v) filing, tempering, etc.

1st Year.—Drawing of alphabets in classic characters, upper and lower case, punctuation, numbers, Roman, antique, Elzivir, Italic; drawing with the pen, with the pencil, ornaments, arms, figures, ornamental letters, borders, etc. Engraving on copper, cut of gilding irons, plaques, engraving of simply shaded subjects, etc. Steel engraving, cutting and dressing the tool, roughing out vignettes, drawing upon zinc, exercises with the engraving tool, having for their object the conferring of the necessary facility of use.

2nd Year.—Drawing, continuation of the study of classic characters, composition of titles, ornamental letters drawn by the pen, figure and ornament drawing with the pencil. Engraving on copper or on steel, retouching the rough of the previous year. Graduated exercises with the graving-tool.

In the 3rd and 4th years the course is much the same, but more advanced. The aid rendered to engraving by the use of photogravure and by mechanical drawing is fully demonstrated.

In the case of pupils who are not sufficiently skilful to follow the whole course with advantage, a certain amount of partial specialisation is permitted. This allows such pupils to perfect themselves within a more limited field.

34. *Copper Engraving, Ecole Estienne.*—While the skill of the engraver is, in a sense, merely identical with that of the artist in drawing, he has, in addition, to acquire that manual facility which can only come from daily practice with the graving-tool. The course is four years.

1st Year.—Knowledge of tools, copper, the graving-tool and its various sizes, mode of holding, first elements of engraving with different tools, drawing of common objects. Copying of engraving, composition.

2nd Year.—Varnishing a sheet with soft and with hard varnish; blackening the varnish, preparation for the calque. Practical exercises in taking the calque of a drawing, placing it on the varnish, and tracing the silhouette with the graving-tool. Various designs, *masques*, fragments from the antique, from nature, ornaments, figures, etc.

3rd Year.—Continuation of the study of drawing. Complete antique drawing. The graving of parallel lines; cutting the second and third time on the same line. Lines at right angles, lozenge-shaped grain. Practical exercises involving the use of the graving-tool for parallel lines, a decorative subject and a portrait being treated. Inconvenience of lines much inclined. Principles of making third and fourth cuts with two already made. Practical exercises in engraving with two, three, or four sets of lines. The engraving of a drawing from nature, made by the pupils.

4th Year.—Practical exercises, based upon the work of celebrated engravers. Portraits, figures, landscapes, animals, by the various ordinary means. The engraved vignette. Generally advanced work.

35. *Copper-plate Printing, Ecole Estienne.*—The general aim of the course is to educate workmen capable of undertaking all forms of copper-plate printing, viz., those that represent paintings, oil and water-colours, pencil drawings, etchings, photographs, etc., the drawing being made upon plates engraved by means of graving-tools, nitric acid, or in various other ways, such as the process followed in aquatints, heliogravures, etc. The view taken is that the pupil should be an all-round craftsman when he leaves the school.

The

The various forms of printing referred to involve, of course, differences of treatment; and the aim of the school is to qualify the workman, not merely as a specialist, but for the entire range of the work, from the printing of visiting cards up to the artistic reproduction of the works of great masters. The work extends over the four years, and is divided pretty much as follows :—

1st Year.—Description of the press for copper-plate printing; its construction and use; handling of its accessories; method of mounting; the pulling of proofs.
The various blacks used in copper-plate printing, their preparation and value, quality of the oils and colours. Method of braying in the production of blacks and colours. The various papers, their qualities and characteristic features.

2nd Year.—Practice with the copper-plate press; manufacture of various blacks for heliogravure, engraving, aquatints, photogravure, visiting cards, etc. The pupils are exercised in each class of work.

3rd Year.—The work is made progressively more difficult. Geographical plates of three or four different colours are printed, the treatment with various kinds of paper more closely studied.

4th Year.—General recapitulation of the work of the previous three years. Printing upon "*papiers de luxe,*" such as Japan, satin, parchment, "*chine-chine volant*" and "*appliqué,*" Whatman's paper, etc. Mode of preparing various papers, materials, and skins.

36. *Gilding on Leather, Ecole Estienne.*—The course is four years, and includes complementary courses on marbling, gilt-edging, chasing, etc. The details are roughly as follows :—

1st Year.—Filleting the back, palettes, narrow fillets, medium and broad, upon sheepskins; the whole done cold. Theoretical instruction and demonstration of the use of various tools.

2nd Year.—More elaborate work; gilding on the back and sides of a book. Treatment of different styles. Commencement of practical gilding on books furnished by the Bookbinding Department.

3rd Year.—Composition of borders. Composition of various styles of ornamenting.

4th Year.—More advanced work, gilding on silk and velvet, etc., gilding of volumes furnished by the Bookbinding Department.

37. *Industrial Photography, Ecole Estienne.*—In this department there are no less than three instructors, who endeavour to bring their pupils into touch with the incessant progress made in this branch of industry. It is not sufficient merely to obtain good results, it is necessary that these results should be obtained quickly. A scrupulous care, therefore, must be kept from degenerating into mere finicking. It is essential that a true industrial process shall be both sure and constant, as well as rapid and cheap. It is endeavoured to give such information as will assist toward the production of the polychromes, which are attracting considerable attention at the present time. The course is divided as follows :—

Photographing and printing on sensitised paper for the collodion wet process, four years. In the dry process (gelatino-bromide), the pupils diverge at the end of their first year, and they work to the end of the fourth year. For *phototypogravures* they also specialise at the end of the first year; so also for *photocollography* and *heliogravure*, so that the first year is common to all the courses. The details of the courses hardly require to be stated.

38. *General remarks on the Ecole Estienne.*—The Ecole Estienne aims at making its pupils thorough workmen of an intelligent grade. It prides itself on its practicality, and yet it is obvious from the information that has been afforded that the theoretical thoroughness of the training leaves but little to be desired.

The conception followed is that the workshop is the adjunct and completion of the school, the formula adopted in France being "*l'atelier complétant l'école,*" instead of "*le cours théorique complétant l'atelier,*" which is there regarded, rightly or wrongly, as that of certain countries, notably our own country (England) and America.[1]

There can be no doubt that the broad lines of the theoretical instruction, so closely co-ordinated and associated with practical work in the workshop is of the highest advantage.

A feature of the history of the school worthy of mention is the large number of donations it has received. No less than 160 persons had made substantial donations of material or money to the school.

39. *Municipal Schools for Drawing.*—Paris possesses technical schools known as *Ecoles municipales de dessin.* The *Ecole Bernard-Palissy* is one of these, having a four-year course, the first year being a preparatory year. In the second and subsequent years, the pupils are divided into four sections—painters and decorators, designers for materials, sculptors, ceramists.

The subjects treated in the Preparatory year are :—Modelling from plaster casts, plants, etc.; Linear Drawing; Drawing from plaster casts of plants and flowers; Drawing of Ornaments.

The work of the following years is specially adapted to the needs of each section, and runs roughly as follows :—

(1) Perspective. Theory and Application. History of Art and Analysis of Style. Composition. Drawing from large casts. Figures and Ornaments. Anatomy. Modelling. Drawing. Practice in the workshop.
(2) Drawing. History of Art. Composition. Practice in workshop.
(3) and (4) Perspective. History of Art and Composition. Drawing. Anatomy. Modelling. Practice in the workshop.

The *Ecole Germain-Pilon* is a school of similar cast. It has a three-year course. The subjects are :—

Year I.	Year II.	Year III.
Geometry. Decoration. Architecture. Water-colour Painting. History of Art. Modelling.	Perspective. Anatomy. Geometrical Tinting. Passementerie. Decorating Work. History of Modern Art. Practical Exercises.	General application of the previous work.

It is not proposed to give detail.

There are other schools of a technical type which may be passed over.

40.

[1] "Le formule adoptée . . . le cours théorique complétant l'atelier, qui est celle de certains pays étrangers, notamment de l'Angleterre et de l'Amerique," are the words in which the opinion is expressed.

40. *Technical Instruction for Young Women.*—There are schools for young women in Paris known as *Ecoles professionnelles de jeunes filles* to which reference may now be made.

Of these, the *Ecole rue Fondary* in the oldest. It was started in 1881, and has occupied its present position since 1884. Pupils enter it when they are between 13 and 15 years of age, or if they have the *certificat d'études* they may enter at 12. The instruction may be divided into two branches, viz., general and technical. The duration of the course and apprenticeship is three years, and is adapted to the following callings and work, viz.:—

Dressmaking, corset-making, lingerie, costumes, boys' clothes, embroidery for costumes and upholstering, artificial flowers, tips and hat ornaments, etc.; ironing. In the last instance the apprenticeship is, however, for only two years.

Besides the above, there are a number of similar schools, for example, the *Ecole Jacquard, rue Bouret* has much the same programme. Ironing, however, is omitted, and the making of straw-hats is included in the course.

The school in the *Rue de Poitou* teaches dressmaking, embroidery, the making of costumes or confections, painting, and industrial drawing. The schools in the *Rue de Bossuet, Rue de Ganneron*, and *Rue de la Tombe Issoire* are somewhat similar in character, and need not be referred to in detail.

41. *Technical Schools for Masons.*—Besides those previously mentioned, there are many other forms of technical schools to which reference may now be made. For example, the Societies of Masons and Stone-cutters of Paris (*Cercle des Maçons et Tailleurs de Pierre*), founded in 1867, have established trade courses of the following character, viz.:—

Primary Course (three divisions).—Reading, writing, grammar, grammatical analysis, orthography, arithmetic, the conceptions of geometry, short course of history and geography.

Course in Geometry and Drawing (four divisions).—The use of drawing instruments, geometrical figures and lines, tracing, details of construction, architectural *motifs*, plans, sections and façades, free-hand sketching, tinting and shading.

Course in Quantity-surveying and Accountancy (two divisions).—Dimensioning, measuring up, sketches, general plans, mode of construction, nature of materials, evaluation of work as a whole, stonework.

Course in Descriptive Geometry and Stone-cutting (three years).—This course deals with the complicated forms of stonework found in stairways, arches, drawings, etc.

In the library there is a collection of stones, small models, drawings, and ornamental drawings of suitable formations.

Another series of professional courses is that provided by the Syndical Chamber of Masons and Master Builders, Paris (*Chambre Syndicale des Entrepreneurs de Maçonnerie de la Ville de Paris*). These provide courses of instruction in linear drawing and geometry, the study of construction in all its details, the course in stereotomy, and a course in quantity-surveying.

A similar course is given by the Syndical Chamber of Working Masons and Stone-cutters (*Chambre Syndicale des Ouvriers Tailleurs et Scieurs de Piérres*). The object of these courses, which include linear drawing, the preparation of diagrams for stone-cutting, manual work, general manipulation, etc., is to perfect the workmen in their craft.

42. *Technical Schools for Carpenters and Joiners.*—Similar courses are established for carpenters by the *Chambre Syndicale des Entrepreneurs de Charpente.* Pupils must be French, and at least 14 years of age, the course opening in October and closing in February. Carpentry is taught four days a week in each of the schools, and the courses therein include geometry, quantity-surveying, and practical carpentry, as well as the necessary professional drawing.

A Professional School of Joinery, established in 1885 under a more lengthy title, but known since 1896 as the *Ecole Professionnelle Menuiserie*, gives a course divided into three sections, known as the elementary and middle course, the higher course, and the course in modelling respectively. These commencing in September and closing in July, are gratuitous, and extend over three years.

The elementary and middle course embraces preliminary notions, definition of geometrical figures, demonstration of the nature of solids, plane geometry, geometrical figures and drawing, ordinary curves.

The higher course embraces descriptive geometry and its application to joinery, study of staircases, of arches, the architectural ideas applied to joinery, study of complete working plans.

The course in modelling embraces the actual execution of work studied theoretically in the second year. Six hours a week are devoted in each year to these several sections of work.

The working carpenters of Paris have also a professional school (*L'Ecole Professionnelle des Ouvriers Menuisiers*). This divides its instruction into a theoretical part, dealing with plane, solid, and descriptive geometry, decorative work, style, and a practical part dealing with the various assemblages, staircases, arches, etc., presenting technical difficulty to the practical joiner.

Professional courses of the Syndical Chamber of Master Joiners (*Chambre Syndicale des Entrepreneurs de Menuiserie et Parquets*) is more elaborate than the preceding. The courses, which last for four years, open in October and close in April. The programme of the work is as follows:—

Subjects.	Years and Hours per Week.			
	I.	II.	III.	IV.
Plane geometry	2	...	...	...
Technology	2	2	...	...
Solid geometry	...	2	...	...
Descriptive geometry	.	...	4	...
Various styles of architecture	2	2	2	2
Joinery	...	...	...	4
Totals	6	6	6	6

The

The "*Union Syndicale des Ouvriers Menuisiers*" of the Department of the Seine provides a course in drawing, dealing with plane and descriptive geometry, linear drawing as applied to joinery, study of plans with different scales, quantity-surveying, the modelling of the various works drawn and studied.

43. *Courses for Plumbers, etc.*—The Syndical Chamber of Plumbers, etc. (*Chambre Syndicale des Entrepreneurs de couverture, plomberie, assainissement et hygiène de Paris*), have established theoretical and practical courses dealing with the following subjects, viz.: Hygiene, the fitting of taps, cocks, and material generally for the distribution of water; physics, and electricity, chemistry, general plumbing, geometry, matters relating to gas service, sanitary matters, practical work, and quantity surveying. The courses open in October and close in March, and last two years.

44. *Professional course for Locksmiths, etc.* A two-years' course has been established by the *Chambre Syndicale des Entrepreneurs de serrurerie et constructions en fer.* The course opens in November and closes in April, four hours a week being devoted thereto in the evenings of each year.

The first year is devoted to linear drawing as applied to ordinary locksmithing, plane geometry, the reading of plans, details of locks.

In the second year there are two divisions. In the first the subjects are locksmithing as applied to construction, complete drawings with details, hardware, and ironmongery generally.

In the second division the subjects are descriptive geometry, the principles of resistance, the drawing of diagrams and of ornamental and artistic locksmithing.

The professional courses of the Syndical Chamber of the working locksmiths (*Chambre Syndicale des Ouvriers serruriers en batiment et des parties similaires*) are somewhat different. They open on the 1st October and close in the beginning of August. The programme of work deals with all matters relating to locksmithing, both ordinary and artistic, the arrangement of bells and telephones on houses, the drawing of plans and diagrams, and the fitting up of dwellings, etc., with locks, bells, telephones, etc., etc.

45. *Schools for Painting and Decorating* (*Buildings*).—A professional school of painting and decorating was established in Paris by a private society. Its courses are entirely gratuitous. The expenses are defrayed by the society itself. The instruction is given during the evening and on Sunday morning. The latter time is specially devoted to the study of harmony of tones, because of the daylight. The Syndical Chamber of Decorative Painters has voted for the maintenance of the school a first instalment of 1,500 francs and the Syndicate *l'Alliance* 100 francs.

46. *School for Furniture Manufacturers.*—This school opens in September and closes in July, sixteen hours a week being devoted to the courses of instruction. It is situated in *Rue de la Roquette.* The instruction is intended for apprentices, workmen engaged in the furniture industry, viz., cabinetmakers, wood-carvers, artistic joiners, wood turners, workers in marquetry, upholsterers, modellers, chasers, makers of billiard tables, moulders, etc.

The theoretical part of the course comprehends linear drawing, the production of working sketches and plans, the theory of style, the history of art, etc., architecture in regard to its relation to furniture, decorative and ornamental sculpture, modelling. This occupies about ten hours a week. The course in moulding, modelling, and sculpture, with plaster and applied to furniture, occupies about four hours a week, and a course in woodwork about two hours a week.

A Parisian association of decorative upholsterers, known as the *Patronage des Apprentis Tapissiers-Décorateurs*, founded in 1872, has established courses for the professional instruction of apprentices and junior workmen. These commence in January and close in June, and they last two years. They embrace elementary geometry, drawing as applied to decorative upholstering, the principal features of architecture, the general features of decorative composition, the cutting of materials on geometrical principles (a subject which is treated both theoretically and practically). Twelve hours a week are devoted to the subject in each year.

In 1866 a furniture maker, *Lémoine*, also established a school for apprentices in cabinetmaking under the *Patronage Industriel des enfants de l'ébénisterie.* The course lasts throughout the year, save for two vacations of a month each. The courses are:—

Drawing at sight from the round, modelling, drawing applied to furniture construction, elementary, descriptive, and applied geometry, perspective, manual instruction in marquetry, turning, joinery, cabinet-making, sculpture, designing, etc.

47. *Courses for Working Mechanics.*—French working mechanics, engineers, etc., in the general federation (*Fédération générale Française professionnelle des mécaniciens et Chauffeurs des chemins de fer et de l'industrie*) have established courses in a large number of centres for persons following their occupations. These courses commence in October and close in April, and deal with heating, mechanics, industrial mechanics, and electricity, etc. The lectures are illustrated with diagrams, models, and the society has a library of treatises on steam, electric, and similar engines.

A society somewhat similarly constituted, but of a much more limited character (viz., the *Union Centrale des Chauffeurs conducteurs et mécaniciens du département de la Seine*), has established courses commencing in October and ending in March, with the object of providing theoretical and practical instruction in regard to materials for combustion, the construction of furnaces, flues, and chimneys, the management of steam apparatus, the construction and management of automobiles, the general features of

of the industrial employment of electricity and of the transmission of power. The courses are completed by visits to suitable establishments. The partition of time in the two years which the course lasts is as follows:—

Subjects.	Years and Hours per week.	
	I.	II.
Heating, management of Machinery	$4\frac{1}{2}$	8
Industrial Electricity	2	3
Automobiles, construction and management	2	3
Total	$8\frac{1}{2}$	14

48. *Professional Schools for Jewellery Manufacture.*—The Syndical Chamber of Jewellers (*Chambre syndicale de la bijouterie, joaillerie, orfèvrerie et des industries qui s'y rattachent*) have established courses of instruction, as follows:—

Elementary geometry, linear drawing, drawing from the round, elements of architecture, linear composition, history of style, composition in various styles, compositions from plants, sculpture, and the industrial application of the preceding. There are annual examinations of drawing, and also of technical work, throughout France, in which apprentices, junior, and ordinary workmen can take part.

Another professional school of the same character is the professional school of imitation jewellery (*Ecole professionnelle de la bijouterie imitation et des industries qui s'y rattachent*). This was founded in 1873. It has a four-year course, commencing in September and ending in July, each subject being taught for ten hours a week during each year. The subjects of instruction are:—

Industrial drawing, modelling, elements of geometry, floral drawing, jewellery, engraving, chasing repoussé work, drawing, higher drawing; and besides these, there is a general elementary division.

49. *Schools for Wheelwrights, for Carriage and Coach Builders.* A four-year course, commencing in October and ending in March, has been established by the Syndical Chamber of Carriage-builders (*Chambre syndicale des ouvriers en voitures*). Created in 1872, this was soon assisted by the municipal council, which subsidised it first in 1875.

The instruction consists of theoretical instruction in ironwork, ten hours a week; and theoretical and practical manual instruction in woodwork, to which ten hours a week are also devoted.

A course established in 1881 by the Syndical Chamber of Wheelwrights (*Chambre syndicale des ouvriers charrons du départment de la Seine*), commencing in October and ending in March, consists of two distinct parts, viz.:—

(1) Joinery, or the art of building the body of the carriage.
(2) The mounting, or union of the different parts constituting the carriage as a whole.

The courses are held on five days a week at 8–10 in the evening, and consist of lectures and practice, the charge for them being 2 francs a month (1s. 8d.).

Courses are also given by a society for professional instruction in carriage building (*Société d'instruction professionnelle de carrosserie*), founded in 1878, under the patronage of the *Chambre syndicale des carrossiers* of Paris. The courses commence in October and close in April, lasting three years in each of the two divisions, viz.:—

(1.) Forge work, locksmithing, etc., wheelwright's work.
(2.) Joinery, etc.

There is also what is known as an independent division.

One instruction, which takes place from 8–10 in the evening, embraces—

Linear drawing, practical geometry and mechanics, carriage building, mounting, and completing.

Another course is provided by the "*Société des Compagnons charrons du devoir.*" Every Tuesday is devoted to the joinery of carriage buildings and to carriage mounting. From Wednesdays to Saturdays inclusive, there are lessons in drawing and practical courses.

50. *Courses in Paper Manufacture.*—The Syndical Chamber of Paper Industries (*Chamber syndicale du papier et des industries qui le transforment*) have established gratuitous courses for professional instruction, and also examinations in practical work. The courses take place from 8 to 10 in the evening from Monday to Thursday inclusive, and on Sunday mornings from 8 to 11. There are two divisions, one embracing apprentices and young employees of both sexes of the 1st and 2nd year, and the other of the 3rd and 4th year. The subjects of instruction are the following, viz.:—

Primary instruction, general professional instruction, special apprenticeship instruction.

The first is represented by French, arithmetic, commercial correspondence, and book-keeping; the second embraces the history of the manufacture of paper and its derivatives, industrial geography, the general conceptions of industry and drawing. The industrial drawing embraces a course of geometrical perspective, and linear drawing and the drawing of ornaments, and a special course of geometrical drawing in connection with the production of cartons.

The special apprenticeship instruction bears upon the manufacture of various kinds of paper and cardboard, etc., its cutting, mounting, and so on.

The whole of the courses are absolutely gratuitous, and as in most of the preceding cases there are rewards in the shape of money, medals, silver, bronze, etc., boxes of tools or books for meritorious pupils.

The

The same time is devoted to each subject in each year, the courses beginning in October and ending in April. The time devoted to the various subjects per week are as follows:—

Subjects.	Years I to IV. Hours per Week each year.
Manufacture of Paper	2
Manufacture of Cardboards, etc.	$1\frac{1}{2}$
The cutting to different sizes, folding, making indexes, etc.	$2\frac{1}{2}$
Professional History, Industrial Geography, French Language ...	1
Industrial Conceptions, Arithmetic	1
Industrial Drawing	2
Special Geometrical Drawing	$1\frac{1}{2}$
Total	$11\frac{1}{2}$

The school possesses a special industrial *museum*, containing samples of all raw products used in the manufacture of paper, specimens of papers of various qualities and shapes, samples of various products of interest to commerce and to the industries connected with paper manufacture, ink, wax, pens, pencils, etc. It has also a special library of treatises on the manufacture of papers and cardboard, on printing, engraving, bookbinding and similar matters.

51. *The School for Millers.*—The establishment of this school, decided upon in 1891, made it really a *school of correspondence*, for the instruction is carried out by means of the *Journal de la Meunerie* (The Milling Journal). This is the official organ of the school, and is sent to each pupil belonging thereto. Programmes of the instruction are drafted bearing on the milling of wheat, on flours or farinas, cleaning, grinding, converting, sifting and salting, also on the application of steam and hydraulic power, storage, general conceptions of baking, yeasts, leavens, water, kneading, ovens, etc. The courses open in November and close in September. A written and oral examination is held at the termination of the course.

52. *Professional School for Baking.*—The school of Bakery, Paris (*Ecole de boulangerie de Paris*), was established by the mutual association of working bakers of the Seine, in 1895. The school obtained in the following year a municipal subsidy of 2,000 francs which enabled it to extend its courses to the various workmen. Having established a co-operative society for the development of mechanical baking, it handed over the municipal subsidy in return for a building in which theoretical courses could be given, and where it could receive pupils and young workmen arriving from the country, and thus lend its material for the practical demonstrations of the school. The courses are (i) practical and (ii) theoretical, and are held in the *rue Boyer-Barret* and the *rue Jean-Jacques Rousseau* respectively. The subjects of instruction are the following:—

Study of the flours, farinas, etc., which may be used in baking. Chemical analysis. Applications of mechanical kneading-troughs. Studies concerning the heating of ovens by wood, coal, and gas. Applications of the heating apparatus. Study of ferments, their assimilation and function. Practice in all systems of farrification. Course upon the markets of grain and farina.

The time devoted to each subject is two hours per week, as follows:—

(1) Mechanics, (2) Heating the oven, (3) Baking, (4) Hand kneading, (5) Analysis and ferments, (6) Mechanical kneading.

53. *Courses for Tailors.*—The Incorporated Body of Tailors of the Seine (*Solidarité ouvrière des tailleurs de la Seine*) without receiving any municipal or state subsidy, have established on their own initiative professional courses during the hours of from 8 to 10 in the evening. These lessons relate to the making of patterns for cutters, the practical work of cutters, and making up. The year is divided into two courses.

More extensive courses have been established by the *Comité de patronage des apprentis tailleurs.*

The work includes measuring, cutting-out, fitting, stitching, etc. The technical outfit of the school includes everything necessary for tailoring and such apparatus as sewing-machines, pressing-irons, and so on. The course lasts three years.

Another course is established by the Master Tailors of Paris (*Union fraternelle et syndicale des maîtres tailleurs de Paris*). The matters specially attended to are:—

(i) Cutting by the process generally known as the method of proportion, for men's, women's, children's, and for all sorts of civil and military clothing.
(ii) The popularising the scientific systems of *mésurage integral* and *triangulation.*
(iii) Study of the difficult parts of tailoring.
(iv) Mutual instruction.
(v) Demonstration of the use of various tools invented for cutting.
(vi) Common commercial knowledge.

54. *Courses for the manufacture of artificial flowers, feathers, etc.*—These courses are established by a Society that takes under its care children employed in the artificial flower industry (*La Société pour l'assistance paternelle aux enfants employés dans les industries des fleurs et des plumes*), and dates from 1866. The course opens in April and closes in March, and is of three years' duration, one and a half hours being devoted to each of the four different subjects per week in each of the three years.

The courses are taught as follows:—History of the artificial flower industry, general ideas of botany as applied to the floral industry, the origin of the raw products used, general zoology of the birds most commonly used in connection with the feather industry, the tools required, special processes, importation and exportation.

Representation from plaster casts, and from nature also, of floral ornaments, and of birds or parts of birds (wings, heads, etc.)

In this case the practical instruction is given in the workshops in which the children are apprenticed.

There is a museum of material for intuitive instruction, illustrating both the elements of natural history and the technical features of the instruction, and there is a library of about 450 volumes.

55. *Courses in coiffure.*—The Syndical Chamber of Hairdressers of Paris (*Chambre syndicale ouvrière des coiffeurs de Paris*), have established a series of practical examinations in coiffure, and it exhibits permanently in the *Palais du Costume*, a series of wax busts with various coiffures for ordinary occasions, for the evening and for the theatre.

56. *Professional Courses in Orthopædical Mechanics.*—The courses last from one to three years, and commence in October and terminate in April. These deal with orthopædical mechanics, prothetics,[1] the apparatus for the treatment of hernia and similar matters. The courses are as follows :—

(i) Course in anatomy and the application of apparatus, definition of the various bones, general knowledge of the articulation of the skeleton, general ideas as to the muscles, nerves, and blood-vessels of the body.

(ii) Course in mechanical physiology.

(iii) Course in pathology as applied to orthopædical mechanics, and modifications in the state of certain parts of the human body subject to orthopædical affections.

(iv) Course in metal-work for orthopædical mechanicians.

(v) Course in technical drawing as applied to various orthopædical apparatus.

57. *Concluding remarks.*—The preceding account gives, necessarily, a very imperfect view of what is done in Paris for the technical education of citizens, and it is of course quite impossible to give detailed courses for each branches of instruction.

The work done in the *Ecole Estienne* may be taken as typical of the thoroughness of the French scheme of instruction, and has been given in detail on that account. Those who qualify in the various courses turn out, as a rule, at once qualified workmen and workwomen. It must not be supposed that the account given is in any way exhaustive, it is rather to be regarded as typical. Taken however with what has already appeared in the Commissioners' reports as to the manual instruction in connection with higher primary education, and with the next chapter, it will serve to give a fairly comprehensive idea of the lower phases of technical education.

It is obvious that the provision made in Paris for technical education is very thorough.

A feature worthy of special note is the part taken by organised labour for the improvement of their craftsmanship. *Instead of being opposed to the education of the young, who later will enter into active competition with them, they now provide out of their own pockets for their education.*

---

[1] Matters relating to artificial limbs, etc.

CHAPTER X.

Continuation, Trade, and Lower Technical Schools of other French Cities.

[G. H. KNIBBS.]

1. *Introduction.*—The preceding chapter has dealt with the continuation of education in its technical forms, from the time the primary school is abandoned, only for the city of Paris. A comprehensive idea of the provision for technical education made by France involves reference to that which is to be found in other parts of France. Commercial schools will be dealt with in the latter part of the report, and will not be further referred to in this chapter.

2. *Practical Schools of Industry for Boys.*—Distributed throughout France are a number of schools known as practical schools of industry (*Les écoles pratiques d'industrie de garçons*) for example, taking the "départements" in their alphabetical order, such schools are to be found in Marseilles, Montbéliard, Romans, Brest, Nîmes, Béziers, Cette, Rennes, Grenoble, Pont-de-Beauvoisin, Morez, Saint-Etienne, Saint-Chamond, Firminy, Saint-Didier-la-Seauve, Agen, Rheims, Lille, Fourmies, Boulogne-sur-Mer, Le Mans, Rouen, Le Havre, Mazamet, Limoges, Epinal.

As to the significance of these schools for the technical education of France, a few examples may be taken and it will not be necessary to develope detailed programmes, for the details have been sufficiently illustrated in the previous chapter.

The practical schools of industry are usually organised to give instruction lasting over a period of three years, a portion of it being of a general character, the balance being industrial or workshop practice. The latter occupies by far the larger number of hours per week.

The general instruction is arranged as follows:—

Ecoles pratiques d'industrie de garçons.

General Instruction.

Subjects.	Years and Hours per Week.		
	I.	II.	III.
French ...	3	3	1½
History ...	1½	1½	......
Geography	1½	1½	......
Natural History and Hygiene ...	......	1½	1½
Physics ...	1½	1½	......
Chemistry	......	1½	1½
Arithmetic	1½	1½	1½
Accountancy	......	......	1½
Totals	9	12	7½

The industrial instruction is thus arranged—

Industrial Instruction.

Subjects.	Years and Hours per Week.		
	I.	II.	III.
Wookshop Practice	30	30	33
Drawing	6	6	6
Geometry	1½	1½	1½
Mechanics	......	......	1½
Industrial Economy	......	......	1½
	37½	37½	43½

To the above must be added *studies*, amounting to nine hours per week in each year.

3. *Practical Schools of Industry for Girls.*—Similar schools for girls (*écoles pratique d'industrie de filles*) are also widely distributed, though they are not so numerous as the boys' schools of industry. They exist in Marseilles, St. Etienne, Nantes, Boulogne-sur-Mer, Rouen, and Le Havre.

The programme of the schools is somewhat different from that of the boys' schools of industry, though the main division is identical. The

The general instruction is organised as follows:—

Ecoles pratiques d'industrie de filles.

General Instruction.

Subjects.	Years and Hours per Week.		
	I.	II.	III.
French	3	3	1½
History	1½	1½	......
Geography	1½	1½	......
Natural History and Hygiene	......	1½	1½
Domestic Economy	......	......	1½
Physics	1½	1½	......
Chemistry	......	......	1½
Arithmetic	1½	1½	......
Geometry	......	1½	1½
Accountancy	......	......	1½
Ethics	......	1	......
Writing...	1	......	......
Ordinary Sewing and Cutting-out	3	1½	1½
Totals	13	14½	10½

The industrial instruction is arranged as follows:—

Industrial Instruction.

Subjects.	Years and Hours per Week.		
	I.	II.	III.
Workshop Practice	24	27	30
Drawing	6	3	3
Totals	30	30	33

To the above must be added a further six hours a week for *studies*.

4. *Administrative Organisation.*—The practical schools (*écoles pratiques*), including those, the programme of which was given above, are placed by the law of 26th January, 1892 (Art. 69) under the authority of the *Minister of Commerce and Industry.* Under the Minister is a *Committee of Inspection*, consisting of the following persons and officers:—

(1) President, the Director of Technical Education.
(2) Inspector-General of Technical Education.
(3) Delegate of the Inspector-General of Public Instruction.
(4) The inspectors of practical schools.
(5) District Inspectors (*Inspecteurs régionaux*), who have for two years at least been specially charged with the inspection of practical schools for at least two years.
(6) Secretary, the Chief of the Central Administration of the "*Département.*"

The function of the Committee of Inspection is purely consultative.

The Inspector-General of Technical Education has under his jurisdiction the whole of the establishments teaching under the Minister of Commerce and Industry. The Inspectors of practical schools are specially responsible for their detailed inspection.

District Inspectors are charged with the special inspection of such schools. Inspectors of the Departments (*Inspecteurs départementaux*) also frequently inspect the practical schools in their districts (*circonscriptions*).

The Inspector-General of Public Instruction reviews the purely general teaching in the practical schools. For each school there is an Improvement Council (*Conseil de perfectionnement*) constituted, according as the establishment is "*départemental*" or "*communal*," as follows, viz.:—

(1) President, the Prefect, or the Mayor.
(2) The "*Départemental*" Inspector of Technical Instruction.
(3) Four members appointed either by the General Council or the Municipal Council, as the case may be.
(4) A member appointed by the Minister.

This Council is required to advise the General Administrative Council as to the number of persons who can be received as pupils. It nominates the candidates; it advises also on the list of candidates whose names are submitted to the Minister, the Prefect, or Mayor, as the case may be, for the position of Director or Directrice, or as the chiefs of any branch of the schools.

The Council is further charged with elaborating the detailed programmes of instruction, the arrangement of time-tables, with assisting at all examinations, with fixing the position of pupils at the final examination, and with all general questions.

5. *Character of the Practical Courses.*—The practical courses in the various schools of industry naturally differ as between school and school, according to local needs and circumstances. It should be pointed out, also, that the practical schools differ extensively from the higher primary schools (*Ecoles primaires supérieures*), in which part of the teaching is professional, and which merely aim at a *preparation* for apprenticeship. The idea of the "*Ecoles pratiques*" is to provide a thoroughly practical form of education such that the pupil on leaving a school may at once enter a workshop as a useful workman.

Something of the type of practical work done may be had from a reference to the equipments of some of the schools; one or two cases are taken at random. For example, in the "*Ecole pratique d'industrie de Lille* there are five forges, six anvils, two vices, the area of the shop being 132 square metres. The carpenter's shop, of the same area, has twenty-one benches, four wood lathes, one band-saw.

The workshop for typography and lithography, lighted by sixteen incandescent lamps, has a 3-horse power engine as a power-source; it has also a Marinoni printing machine, twelve rollers, eight double founts, a guillotine, a hand-press, beside several pieces of minor apparatus.

The photography-room is glazed, has a large manipulation-table, dark-room, and all the materials necessary for every branch of the subject.

Parts of the programme in these schools are often specially developed. For example, in this Lille school a special programme embraces typography, lithographic printing, photography, phototype work, and photogravure.

The teaching staff and its duties will also give some idea of the character of the work done in the school. For example, the teaching staff in the Lille school embraces the following persons:—

(1) The Director, charged with the teaching of physics and chemistry.
(2) The Professor of general instruction.
(3) The Professor of technical instruction, who is also charged with the instruction in geometrical drawing.
(4) The Master in charge of the wood and iron work, charged further with the instruction in ornamental drawing.
(5) The Master in charge of the typography and lithography.
(6) Two master workmen for woodwork, and
(7) Two master workmen for iron.

Sometimes the practical schools of industry also give courses for adults, and in some cases these are gratuitously organised by the teachers of the schools, the instruction being given as a matter of good-will on their part.

The following five weekly courses have been organised in the Lille School on the above lines.

(i) Elementary Physics and its industrial application.
(ii) Photography.
(iii) Weaving.
(iv) Practical mechanics.
(v) Literature.

Naturally these courses are elementary, but they are nevertheless essentially practical in character and are deemed to be of value.

Another example of special work is illustrated in six courses, which are given in the *Ecole pratique d'industrie, Boulogne-sur-Mer*. They are as follows:—

(i) The installation of electric bells.
(ii) The installation of telephones.
(iii) The installation of electric lighting.
(iv) The mounting and care of electric motors.
(v) The charging and maintenance of accumulators.
(vi) Medical apparatus, for which electric current is required.

This course is intended to qualify pupils as working electricians, and is a sort of practical supplement to the somewhat extended series of lessons in electricity belonging to the ordinary course of instruction in physics.

A further example of the type of work done in the practical school may be taken from the *Ecole pratique d'industrie de Rouen*. The general workshop has an area of 225 square metres. It has forty-four vices, two planing machines, two drilling machines, a milling machine, four metal turning lathes, and other apparatus.

The lathe-room, of 185 square metres, has seven ordinary lathes, ten special lathes, a drilling machine, twenty-six vices, besides minor apparatus.

The locksmithing room, 228 square metres in area, had four forges, thirty-nine large vices, three drilling-machines, one metal lathe, and a small electric lighting installation.

The preceding are, of course, on the ground floor. On the first floor there are forty-three benches in the joinery workshop, which is of 520 metres area.

The forge has twelve fires, six of these have fan-blasts.

The motive power is as much as 36 h.p., and the boilers also supply the steam-heaters. It was, some time back, intended to enlarge the work of the school to include the industrial applications of electricity on account of the rapid extension thereof. This has no doubt since been done.

Though not in any way exhaustive, the above is probably sufficient to give a rough indication of the type of work undertaken in the practical schools.

6. *National Apprenticeship Schools.*—This type of school (*i.e.*, the *Ecole Nationale d'apprentissage*) is not essentially different from the practical industry school. It is perhaps well represented by the *Ecole Nationale apprentissage de Dellys*, in Algeria. It has a general workshop, a forge, a joinery, and modelling room, and a wheelwright shop. Its work calls for no special comment. The Departmental apprenticeship schools (*Ecoles départementales d'apprentissage*) are of course similarly organised. That at Angoulême, opened in 1891, may be taken as an example.

The courses are given in the normal school for teachers; they open on 1st October, and close 31st July.

The instruction is theoretical and practical, the latter comprising joinery, turning, modelling, etc., engineers' work, forge work, metal turning, stereotomy.

The

The programme is as follows :—

Ecole départementale d'apprentissage, à Angoulême. Programme.

Subjects.	Years and Hours per Week. I.	II.	III.
Physical Science	2	2	2
Natural Science	1	1	1
Mathematics	4	4	4
Technology or Mechanics	1	1	1
Workshop practice	13	18	20
Industrial drawing	6	6	6
Total	27	32	34

This will give a general idea of the work of this type of school.

7. *National Professional Schools.*—The *Ecole d'Armentières* in the *Département du Nord* may be taken as a type of the Ecole nationale professionnelle. Its workshops are distributed through five buildings, the motive power being furnished by a 30 h.p. steam-engine, which not only supplies the force for the wood-turning machinery, but also, by tele-dynamic transmission, the power required in the weaving room. Its workshops are general workshop, forges, joinery, weaving.

The aim of the National professional school is to initiate young people into the work of their profession, and to give them that dexterity in special knowledge which will enable them to enter technical schools of a high character, or to practically improve themselves.

Students must possess the *Certificat d'études primaire élémentaire.* The work in the National professional school somewhat closely approximates, so far as the general part of the instruction is concerned, to that given in the higher primary schools. The special programme of technical instruction corresponds to the industry in the region where the school is established. For example, at Armentières and at Voiron weaving is the principal subject; at Vierzon the manufacture of agricultural material. The following programme of the work in the *Ecole de Voiron* will give a sufficient general indication of the type of school.

Programme, Ecole de Voiron.

	Subjects.	Winter. Years and Hours per Week. I.	II.	III. Normal.	III. Special.	Summer. Years and Hours per Week. I.	II.	III. Normal.	III. Special.
Literary ...	Ethics, law, polital economy	¾	¾	¾	...	¾	¾	¾	...
	Reading, recitation	1¾	1	1	1	1¾	1	1	1
	Grammar, orthography, analysis ...	2	1¾	1	2	2	1¾	1	2
	French composition	1	1	1	1	1	1	1	1
	History	1	1	...	1½	1	1	1	1½
Mathematical	Geography	1	1	1	1½	1	1	...	1½
	Arithmetic	2	1	...	3	2	1	...	3
	Geometry	2	2	2	5	2	1	2	2
	Calculation, algebra, trigonometry ..	1	1	1	2	1	1	1	5
	Surveying, levelling, mensurations ...	...	1	...	...	...	...	...	...
	Mechanics	...	¾	2	...	...	¾	2	...
	Accountancy	1	1	...	...	1	1	...	...
Scientific ...	Physics	1	1	1½	...	1	1½	2	...
	Chemistry	1	1	1	...	1	1	1	...
	Natural history, hygiene	1	1	...	...	1	1	...	...
	Scientific manipulations	¾	1	1	...	¾	½	...	...
Graphical ...	Caligraphy	¾	½	..	...	¾	½	...	...
	Drawing at sight, sketching	3	1	[1]1	3	2¼	1	[2]1	3
	Geometrical and technical drawing ..	3	4½	4½	6	3	4½	4½	6
	Descriptive geometry	...	...	1	¾	...	...	1	¾
	Industry.								
Technical ...	Special technology	1	1	1	1	1	1	1	1
	Manual work	12½	15½	23	15½	12½	16	23½	16
	General technology	...	...	1½	...	...	...	1½	...
	Modelling and sculpture	...	...	[2]1	...	1½	1	[2]1	...
Various ...	Excursions	...	...	...	...	...	...	4	...
	Modern language (optional)	2	2	2	...	2	2	2	...
	Music	½	½	1½	½	2½	½	½	½
	Gymnastics	¾	1	..	...	¾	1	...	...

[1] For the Weaving section only. [2] For the Joinery section only.

8.

8. *The School of Chemistry and Dyeing, St. Etienne.*—Municipal public courses in physics, chemistry, and dyeing, were established in St. Etienne as far back as 1892, the present school, however, being completely organised only in 1898. The instruction is intended not only for apprentices and dyers but also for young people who wish to enter the industrial laboratories of the district. Its *chief* object, however, is the professional instruction of the working dyers of St. Etienne.

The courses, open in October and close in July, and cover the following subjects, viz.:—
Physics, chemistry, dyeing, practical exercises.

A short indication of the way in which these are taken will be sufficient.

Physics, Generalities, weight, the balance, hydrostatics, density, areometers, statics of gases, Mariotte's law, etc.; barometers, manometers, heat, dilatation, thermometry, calorimetry, changes of state, ebullition, distillation.
Optics, as far as it is necessary to understand the principal phænomena relating to the colour of bodies, and the general theory of colour.
Chemistry—The metalloids and metals, organic chemistry, the fatty and aromatic series, colouring matters.

The instruction is so treated as to shew the relation of the sciences as a whole to the properties of products employed in the dyeing establishments of St. Etienne.

Dyeing—Textile fibres and their examination, their tenacity, elasticity, behaviour under torsion, especially of silk, condition, washing and scouring, bleaching. Treatment of cotton and silk. Dyeing in fresh colours, in bright colours, in various shades, and in white and black. Substantive colouring matters, "*colorantes adjetcifs*," mordanting, vivifying colours, special treatment of silks.

Practical Exercises.—The manipulations or demonstrations in the course are repeated in a completely equipped laboratory, so that the theory and practice of dyeing are thoroughly understood. These laboratories are equipped with the necessary gravimetric and volumetric apparatus so as to allow of precision in the entire range of operations. The course is two years, and the lessons average roughly three hours a week, physics and chemistry being taken wholly in the first year.

9. *Brewing School of Nantes.*—Although the Brewing School at Nantes can hardly be appropriately classed under the head of lower technical schools, this School (*Ecole de Brasserie*) does not exact from its pupils any preliminary scientific knowledge. It aims directly at enabling brewers to acquire a knowledge of matters that have become important to this industry, without any previous special training. The duration of instruction is three months, and the courses cf studies are as follows:—

(1) Chemical analysis, and laboratory practice therein, applied to brewing (dealing with water, malt, barley, beer, and hops.)
(2) Bacteriology and microscopy as applied to brewing, for the control of yeasts, the recognition of the maladies of beer, and isolation of pure cultures of ferments.
(3) The technique of malting and of brewing, indicating the transformations which take place in the course of manufacture, and the means by which they may be controlled.
(4) Practice in brewing, following the various methods employed in France and in foreign countries. Each pupil in turn takes part in the whole process under the supervision of the masters, and takes account of all the operations of chemical or microscopical control.
(5) Supervision and handling of the machinery, the generator, steam-engine, freezing-machine, dynamos, etc.

Five weeks are devoted to analyses, five to bacteriology and microscopy, and two to following the complete operations in brewing. There are three brewings a week.

The technical instruction involves twenty-five to thirty lessons, and is distributed over the first ten weeks. The distribution of the time is as follows:—

(i) Brewing, etc.; (ii) Management of the machinery, each about 22 hours per week; (iii) Theoretical course and analysis, 2 hours per week; (iv) Laboratory practice and analysis, 16 hours per week; (v) Course in bacteriology 22 hours per week; (vi) Practical exercises, 16 hours; (vii) Course in general technique, 3 hours per week.

10. *Hosiery School, Troyes.*—The Chamber of Commerce and the Syndical Chamber of Hosiery Manufacturers founded a school in 1888, known as the *Ecole Française de Bonneterie*, for the education of overseers and factory directors. The course lasts two years; opens in October and closes in August; and the distribution of the instruction is as indicated in the following programme, viz.:—

Programme—Ecole française de bonneterie, à Troyes.

Subjects.	Years, and Hours per Week. I.	II.
Technology of spinning, weaving, and manufacture of hsiery ...	...	2–3
Mathematics, as applied to the hosiery industry ...	...	11
Industrial drawing ...	...	6
Practical work in the machine-shop ...	...	10
Practical work in hosiery manufacture ...	...	14
Elementary technology of textile fabrics, first principles of spinning, weaving, and the manufacture of hosiery ...	2–3	...
Mathematics ...	4	...
History and Geography ...	1	...
Drawing ...	6	...
Practical work in the hosiery workshop ...	20	...
Practical work in the machine-shop ...	10	...
Elementary notions of book-keeping, etc., definition of ordinary terms of commerce and commercial effects[1] ...	...	...

[1] Several lessons end of year.

The

The work of the first year embraces the elementary technology of textile fabrics, the first principles of spinning and weaving, and of the manufacture of hosiery; elementary geometry; arithmetic, including progressions and logarithms; geometrical drawing; sketching and drawing of parts of machines; and practice in the workshops.

The second year work embraces elementary ideas concerning the spinning of cotton and wool; the technology of hose-making; visits to factories; notions of elementary algebra, including the equations of the second degree; continuation of the work of elementary geometry; elementary descriptive geometry and its application; kinematics, as complete as possible; the general precautions to be taken in regard to machinery; notions of industrial mechanics; mechanical work; inertia; composition and analysis of forces; levers, the momentum of force about a point and in relation to a plane; moment of inertia; friction; resistance of material; general notions of industrial physics; industrial applications of electricity; boilers; steam-engines; gas; petrol and hydraulic motors; industrial drawing from sketches made by the pupils, with dimensions; and practical work in the workshops and machine-shops. There are examinations at the end of each year.

11. *The Technical Institute of Roubaix.*—At Roubaix, in the Departement du Nord, there is a school for instruction in spinning, weaving, dyeing, electricity and mechanics, and in commerce relating of course to business in textiles. This school, known as the *Institut technique Roubaisien* was founded in 1895. The chief divisions of the instruction are as follows:—

Section for Spinning.—Raw materials; combing from the mechanical and chemical points of view; scouring, etc., etc.; machines for combing and spinning of wool; the same in regard to the spinning of cotton; twisting; drawing of machines.

Section for Weaving.—Artistic weaving; study of various styles; drawing of ornament and decorative composition; composition of fabrics; industrial weaving; study of threads and numberings; warping, taking in, etc, twills; hand and machine workmen; weaving the various kinds of fabrics.

Section for Dyeing.—Study of mordants and colouring matters; dyeing of the various fibres separately or in a mixture, and every state of preparation; colouring, printing fabrics; preparation of the substances employed, their nature and rôle, and the mixing of them; machines and practical formulæ for various kinds of treatment. Complete study of coal-tar colours, their manufactnre and application.

Mechanical and Electrical Section.—Study of the three great divisions of the principles of mechanics; complete study of the steam-engine. Electric current, measuring instruments, electrical sources, cells, accumulators, dynamos, complete study of continuous current, of polyphase currents and transformers, their application to lighting, to the transmission of energy, and to electrolysis.

Section for Commerce in Fabrics.—General conceptions of commerce and manufacture, accountancy of factories, commercial law, the study of languages, of customs and transport, of commercial and industrial geography.

The arrangement of each day's work is as follows:—The first hour is devoted to special matters; the second to the general course; to electricity, social economy and religion; to boilers and motive power; to accountancy. The third hour is given to the study of languages and drawing. For five days a week the afternoon is devoted to practical work, three hours being spent in each workshop. The pupils are therefore occupied about eighteen hours a week in the theoretical courses, and about fifteen hours a week in the practical courses, and if the studies are continued for the two years satisfactorily, the Diploma of the Institute is given.

It possesses a museum, with a fine collection of fibres and fabrics. Its larger apparatus consists of semi-tubular boiler, 40 h.p. steam-engine, 25 h.p. gas-engine, two generators (representing together about 36,000 watts), accumulator batteries (about 500 ampère-hours), six dynamos.

The school possesses a mechanical workshop, a dyeing laboratory, and a research laboratory.

It is said that pupils, on leaving the school, very readily obtain positions as chief workmen in spinning, weaving, and dyeing establishments. There are both day and evening courses.

12. *Industrial School of Tourcoing.*—This school (*école industrielle de Tourcoing*) has day-courses for the sons of manufacturers, industrial workmen, and tradesmen, etc., who are able to devote the time; and also evening courses for young workmen and employés who wish to become overseers, chief mechanicians, or chiefs in manufacturing departments, in spinning and weaving establishments, etc.

The courses commence in October and end in July. The complete course in all subjects can be taken in four years; but matters are so arranged that it can be extended; that is to say, one can take a long period if needed.

13. *Schools of the Legion of Honour.*—With an object of providing a good education for the daughters of the members of the Legion of Honour, and one that will give them sufficient practical knowledge to honorably earn their living in a manner agreeable to the dignity of their families, three educational establishments, known as the "*Maisons d'éducation de la legion d'honneur,*" have been created, and are administered by the Grand Chancellor (under the control of the Council) of the Order. The instruction is divided into two branches—general and professional. The pupils who receive professional instruction nevertheless continue their classical studies, to which they devote nineteen hours a week. The remainder of the time is devoted to manual work, given in the following ateliers:—

(i) The workroom for cutting-out, confection, and lingerie. (ii) For artistic embroidery. (iii) For music engraving. (iv) For lithography.

The courses commence in October and terminate in July, and relate to the following matters of instruction, viz.:—

Cutting-out and making-up, confection of dresses, lingerie and women's clothing generally.

Artistic embroidery; gold and silver embroidery for military uniforms; church ornaments; composition and drawing of embroidery.

The engraving of music.

Engraving upon stone of musical works.

Cooking, housekeeping, etc.

The

The complete course lasts four years. In the first year there is also commercial instruction, to which are devoted the following number of hours, viz.:—

Book-keeping, 7 hours; commercial law, 1; foreign languages, 9; commercial correspondence, 2; arithmetic, 1; stenography, 4; "dactylography,"[1] 5; caligraphy, 2; and commercial geography, 2.

The industrial instruction is as shewn in the programme hereunder, viz.:—

Programme of the Maisons d'éducation de la Legion d'honneur.

Subjects.	Years and Hours per Week.			
	I.	II.	III.	IV.
Confection and lingerie...	24	24	24	24
Embroidery	24	24	24	24
Engraving of music	5	5	......	......
Lithography	5	5	......	......
Cuisine	$6\frac{1}{2}$	......	......	......

About half as many pupils present themselves for music, engraving and lithography, and for dressmaking and embroidery.

14. *Schools of Horology.*—There are in France several schools of horology; for example, at Besançon, Cluses, and Paris. The schools at Besançon and Cluses are known as *Ecoles nationales d'horlogerie.*

The watch-making industry was introduced into the old province of Faucigny toward 1715. The school at Cluses, established in 1849, is intended to provide a suitable education for those who contemplate as their craft the complete manufacture of any apparatus for the measurement of time, or the manufacture of any fine mechanism, or the manufacture of any parts thereof. The degree of instruction is such as would be useful to young people intending to become manufacturers or chief workmen in such classes of industries. The normal course of studies is three years; the instruction is gratuitous; the pupils are admitted when they are 14, provided they have the "*Certificat d'études primaires,*" or, failing which, they must satisfy the authorities that they have a knowledge of reading, that their writing is free and legible, that their orthography is good, that they understand arithmetic as far as the four first rules, fractions, the metrical system, and simple and compound proportion. The theoretical instruction is always orientated in regard to its application. It embraces French, arithmetic, the elements of algebra, of geometry, of trigonometry, of mechanics, of physics, and especially electricity and drawing.

The practical instruction is given in four workshops. In the first year it comprises preliminary exercises with the file and lathe, the manufacture of small tools, drafting. In the second year, winding apparatus, finishing, dials, cylinder escapements, etc. In the third year, other escapements, compensating balance, the polishing of steel, repairing.

Since 1886 the Cluses School has possessed a workshop for fine mechanics and electricity, the instruction in which is given by two special teachers. Those who have completed their studies in horology and desire to get a knowledge of electrical horology—fast becoming an important subject—and also those who desire to become competent in fine mechanics and in the construction of the finer work for telegraphs and telephones, follow this special course. The number of such students is yearly augmenting.

15. *Weaving Schools.*—The Municipal Weaving School of Sedan (*école municipale de tissage*) may be instanced as a typical weaving school. Founded in 1881, to educate designers of fabrics, it had initially a course of studies of not more than two years. In 1885 this was extended to three years, and is now four years. In 1889 a course of repairing was added for young women.

The courses commence in October and close in August.

The courses may be divided into the theoretical technical instruction and the practical courses.

The programme is as follows:—

Programme of Ecole municipale de tissage de Sedan.

Subjects.	Years and Hours per Week.			
	I.	II.	III.	IV.
Theory of Weaving	10	12	12	4
Practice of Weaving	8	8	8	6
Repairing	12	......	2	......

The school is subsidised by the State and the Municipality.

16. *Various other Schools.*—It is not the function of this report to give an exhaustive account of technical education in different parts of France, but rather to indicate what type of educational provision is made by the nation for its citizens. Many other schools might be quoted. The commercial schools will be mentioned elsewhere.

One might mention such types of schools as those for domestic economy, and cooking and housekeeping; such schools, for example, as are known as *écoles d'économie domestique et de cuisine ménagère.* There are such schools with courses of four years, devoting, respectively, four, six, and eight hours a week to the instruction extending from October to July.

There

[1] Dactylography is typewriting

There is also such a school as that of M. Barrouin, for piano-tuners and piano-repairers, in which even the blind are specially trained; there are also schools for instruction for furriers, for those who deal with art-leathers, and many others, to which reference need not be made.

Sufficient has been said to give a fairly definite idea of French progress in technical education.

17. *The Professional Education of Teachers in Lower Technical Schools.*—When the law of 26th January, 1892, gave its present form to technical education in France, it was at once recognised that in the future there should be some means of ensuring what may be called the pædagogic qualification of teachers of the various subjects in a system of technical education. While there were no difficulties as regards supplementary primary education the same could not be said for the practical forms of technical instruction. Initially, it was possible merely to employ craftsmen for the practical instruction. But later it was decided by the Minister to look to younger men, who, in addition to a more thorough education, possessed also some knowledge of teaching; for example, ex-pupils of the "*écoles normales primaires*" on whom, however, was imposed the obligation of the necessary supplementary studies of a technical character. This gave rise to the institution of teaching sections in technical education.

Even as far back as 1891 there was a normal section of the School of Arts and Crafts (Ecoles des arts et métiers) of Châlons-sur-Marne. Its object was to educate technical instructors for the superior primary schools (*écoles primaires supérieures*), and the so-called professional schools (*écoles professionnelles*) as well as for the manual apprenticeship schools (*écoles manuelles d'apprentissage*). Although the pædagogical training of instructors in the technical schools leaves, as a whole, much to be desired, it is well recognised that something more than mere workmen are necessary, however skilful they may be. That is the most fundamental point in regard to the matter of the qualifications of instructors.

18. *Concluding remarks.*—This brief sketch of technical education in France will reveal that the provision for technical training of the young is very thorough and widespread. The influence of the general state of education in Europe has a very healthy reaction on that of France, and is responsible for the very thorough development of the various courses.

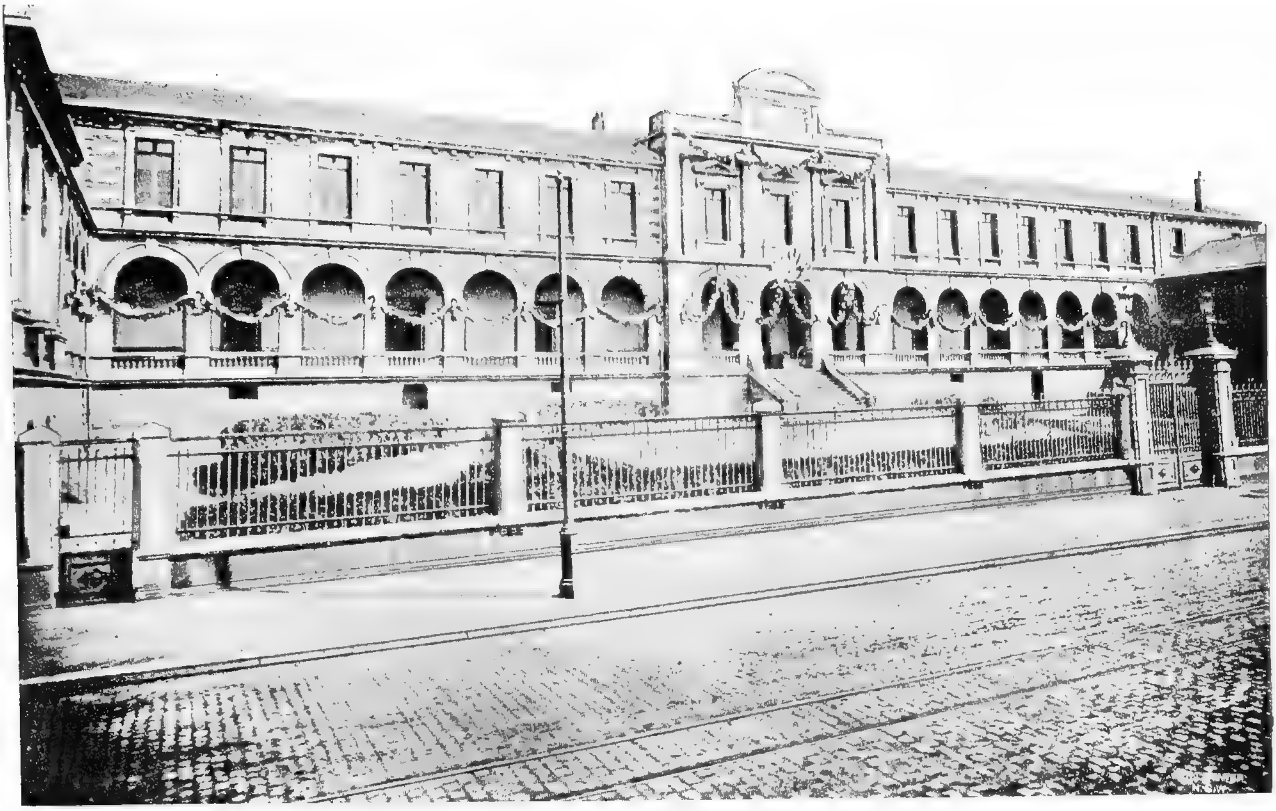
The teaching power is very rapidly reinforced and improved, so that a great development of technical education is taking place.

It is worthy of remark that while many of the courses are occasionally united in a large establishment the tendency to overdo this is carefully guarded against.

It is not necessary to keep technical instruction back, because a series of courses cannot be commenced on a pretentious scale, and we can at least learn from France to make use of existing material to make an adequate commencement in technical education.

We can also learn the folly of leaving our children unprepared for the battle of life, because workmen are anxious to prevent them coming into competition.

CHAPTER XI.



ÉCOLE PRATIQUE D'INDUSTRIE DE SAINT ÉTIENNE.

ÉCOLE PRATIQUE DE COMMERCE ET D'INDUSTRIE DE BEZIERS.
(Atelier de stéréotomie.)

CHAPTER XI.

Continuation, Trade and Technical Schools of Switzerland.

[G. H. KNIBBS.]

1. *Introduction.*—Switerland is justly renowned for the educational provision it has made for its citizens. That provision embraces not only primary, secondary, and university education, but also the lower and higher forms of industrial, technical, and "professional" education.

As far back as 1894–5 Dr. Albert Huber gave an account of the provision made in primary schools for girls.[1] In most of these material was provided gratuitously. Not only was instruction in needlework and similar matter given, but also in domestic economy.

In 1897 Madame Rose Rehfous prepared a statement of the development of this, referring to the type of instruction afforded—domestic economy, hygiene, washing and ironing, cutting-out and dress-making, cooking.[2]

In the same year M. Léon Genoud wrote about the manual work[3] of the Swiss School, and M.M. Aimé Bouvier and François Martin contributed an article on "Professional" Instruction and Drawing.[4] In the same year again, M. Charles Vignier outlined the provision made in the way of continuation schools proper.[5]

It will be seen from a study of the works above referred to, that Switzerland starts the technical education of her citizens in the primary schools—in fact, often in the kindergarten or continuation schools.

2. *Continuation Schools.*—The continuation or supplementary schools of Switzerland are variously organised. They are known as *écoles complémentaires*, *écoles de répétition*, *corsi di ripetizione*, ***Repetirschulen***, ***Ergänzungsschulen***, ***Uebungsschulen***, ***Fortbildungsschulen***, ***Wiederholungskurse***. Such subjects as the mother-tongue, practical arithmetic and geometry, national history and geography, and general geography, book-keeping, elementary horticulture and agriculture, and elementary "professional" teaching—*i.e.*, instruction in the various callings or crafts of local importance are treated. Some of the schools do little more than recapitulate and extend the work of the primary school, others are industrial, trade, or commercial schools.

3. *Supplementary Schools of Geneva.*—The following programme will disclose the character of the *écoles complémentaires de Genève* :—

Programme.

Subjects.	Hours per Week and Years.			
	Boys.		Girls.	
	I.	II.	I.	II.
French	2	2	1	1
Arithmetic	2	......	1	......
Book-keeping	......	2	......	1
Geography and History	1	1	......	......
Geography and Civic Instruction	......	......	1	......
Drawing	2	2	2	2
Domestic Economy	......	......	......	1
Cutting-out and Confection	......	......	......	2

The instruction in these subjects is practically orientated. For example, the *French* includes exercises in redaction, having special relation to industry.

The *arithmetic* includes commercial calculations of various kinds, the first notions of *book-keeping.* This latter subject is treated, so far as single entry is concerned, in the first year, and double entry in the second.

The *drawing*, starting with a recapitulation of the work of the primary school, passes on to perspective, the sections of solid objects, preparation of elevations, etc., the development of surfaces.

The *geography* includes information as to national products, means of transport, ports and centres of commerce, principal industries, export, commercial relations with foreign countries, etc.

In

1 Die Arbeitsschulen für Mädchen in der Schweiz auf der Primarschulstufe. 1895.
2 Travaux féminins des écoles suisses. 1897.
3 L'enseignement des travaux manuels. 1897.
4 L'enseignement professionnel et le dessin. 1897.
5 Les écoles complémentaires en Suisse. 1897.

In the classes for girls, the domestic economy, besides treating of the purchase and care of linen, lingerie, etc., of washing, ironing, repairing, special attention is paid to the question of alimentation. The conditions and essential of good food, its purchase and conservation, receipts for the cooking, etc., of the most ordinary and important viands, of vegetables and fruit, etc., are features of the instruction. Throughout the subjects are treated as far as possible in the manner most directly conforming to the needs of the individual pupil.[1]

4. *Detailed Programme of Practical Work for Girls in Secondary Rural Schools.*—The girls in the rural schools of the Canton of Geneva are very thoroughly taught cutting-out, dressmaking, and matters of that kind. The following outline will give a sufficient idea of the way in which the work is taken :—

DETAILED PROGRAMME OF THE TEACHING OF CUTTING-OUT, SEWING, WASHING, AND IRONING, IN THE RURAL SECONDARY SCHOOLS OF GENEVA. (THREE-YEAR COURSE.)

CUTTING-OUT AND SEWING.

First Year.—Lingerie. Chemise (different shapes), etc. Camisole. Children's garments. Preliminary ideas, study of the measurements ; method of taking them. Pelisse or long cloak. Under-body. Baby's gown, various shapes. Wadded gown. Baby's jacket, sailor costume. Tracing the patterns. Cutting and fixing. Confections in various materials.

Second Year.—Lingerie. Under petticoat. Camisole. Children's garments. Boy's trousers. Waistcoat. Blouse. Ladies' garments. Preliminary ideas, study of the measurements ; method of taking them. Simple bodice to correspond with simple sleeve. Straight skirt. Blouse. Tracing of patterns. Cutting-out and fixing. Confection in various materials.

Third Year.—Lingerie, night-dress. Flannel waistcoat. Man's shirt. Children's garments. Dress for little girl from 8 to 10 year of age Cloak for girl. Ladies' garments. Morning. Dressing-gown. Jacket. Drawing the patterns. Cutting and joining together. Confection in various materials.

SEWING.

In the three years : Recapitulation of the programme of the primary school from the point of view of the care of linen and garments

Various exercises in mending (stockings, linen, garments, tulle, etc.) Sewing exercises. Embroidery.

GENERAL INSTRUCTIONS CONCERNING THE TEACHING OF CUTTING-OUT IN THE RURAL SECONDARY SCHOOLS.

The teaching of cutting-out, in common with all the others, is, as far as possible, of a collective nature. The mistress first of all sets forth the various points of the lesson, gives general explanations, and ascertains, by intelligent questions, if she has been understood, her teaching thereby of necessity assuming a practical character.

The mistress traces on the black-board the design of the pattern to be executed by the pupils in a copy-book. She sees that the necessary measurements for each pattern are registered on the leaf intended for it. The designs are corrected by the mistress by means of a coloured pencil. When a pattern has been well studied it is revised with other measurements, on a detached leaf, then cut out. The measurements are also inscribed on the cut-out pattern.

The confection is then cut out in tissue paper, to the end that the pupil may be accustomed to place the pattern on the material and to give her a correct idea of the shape that the garment is to assume. The paper confections should be simply constructed ; too much time should not be spent on trimming.

Material confections being an application of the cutting-out lessons, should be made by the pupils.

The work of each lesson is estimated by means of marks kept in a special register, the average being taken at the end of each month. This result gives the pupil an idea of the value of her work.

In order that habits of order may be inculcated, it is required that all patterns and confections shall be placed in the order of their date in large envelopes.

The programme terminated, each girl thus possesses a complete collection of the studies performed by her during the year.

WASHING AND IRONING.

Washing.—The various processes in use at the present day. Operations to which they give place. Water, soap, ashes, lye-washing, leakage, slops. The blueing of clothes, the hanging-out. Cases where washing with soap can replace lye-washing. Articles that may be put through the wringer. The washing of woollen and coloured materials. Practical advice.

First Year.—Ironing. Ironing of unstarched linen. Preparation of the table. Manner of using the iron, its heat. Damping. Folding of kitchen linen, cloths, etc. Ironing and folding of the following articles :—Pocket handkerchiefs, serviettes, pillow-cases, eider-downs, table-cloths, aprons, under-skirts, women's chemises, short night-dresses, camisoles, bed-gowns, etc.

Second Year.—Ironing of linen starched with raw starch. Preparation of the raw starch. Starching of coloured and white shirts. Ironing. Folding. Collars. Cuffs. Ironing of linen starched with boiled starch. Preparation of boiled starch. Short petticoat. Children's dresses and pinafores. Blouses. Morning garments. Ironing of lace, embroidery, trimmings, collarettes, etc. Starching and ironing of curtains. Ironing of woollens.

Third Year.—Recapitulation of the programme of the first and second years.

GENERAL INSTRUCTIONS CONCERNING THE TEACHING OF IRONING.

The pupils bring to each lesson linen already washed, the mistress having announced the various pieces required at the preceding lesson, so that they may be nearly alike for the pupils of the same year and that the demonstrations be collective. Individual teaching, which is also necessary, should follow the collective teaching.

All the parts of the programme are arranged in the order of progression, the frequent repetition of exercises ultimately assuring that skill necessary for the ironing and folding of all kinds of linen articles, laces, woollen materials, etc.

The various processes of washing are not performed at school, but are successively explained and demonstrated detail to the pupils.

All the explanations and the practical counsels of the mistress should be written by the pupils in their special note-books. The average of marks awarded will be made up at the end of each month.

The practical value of this type of instruction for the future housewife is obvious.

5. "*Professional Schools*" *and the teaching of Domestic Economy.*—A similar type of school is the "professional school" and school for domestic economy. The following programme for such a school at Geneva will indicate the character of the work. The object of the instruction is to qualify young women thoroughly for their later duties as mistresses of households.[2] They follow on after the sixth year of the primary school, and last two years. Pupils must be 13 years of age, and if they have not a "*bulletin d'examen satisfaisant*" they must pass an entrance examination.

The school-year is 40–42 weeks, and the lessons are given 8–11 and 2–5, thursday and saturday afternoons being half holidays. *Programme*

[1] The words of direction are :—"Le maître cherchera à se rendre compte du but que se proposent les élèves, afin de conformer, autant que possible, son enseignement aux besoins qu' il aura constatés."

[2] "Familiariser la jeune fille avec toutes les occupations qui sont le lot de la femme au sein de la famille ; lui inculquer des habitudes de travail, d'ordre et d'économie, lui fairè comprendre tout ce qu'il y a de noble et de bienfaisant dan l'accomplissement des humbles devoirs de la vie domestique, cultiver les facultés de son esprit, éclairer sa raison, former son caractère et son coeur, tel est le but élevé auquel aspire l'école professionnelle et ménagère."

Programme of an "Ecole professionnelle et Ménagère" at Geneva.

Subjects.	Hours per Week. 1st Year.	Hours per Week. 2nd Year.	Subjects.	Hours per Week. 1st Year.	Hours per Week. 2nd Year.
French	3	2	Mending and Darning	2	1
German	4	3	Embroidery	...	1
Accountancy and Calculation ..	3	3	Cutting-out and Confection of Garments	2	4
Commercial Geography	1	1	Cookery	2	2
Domestic Economy	2	1	Washing and Ironing	2	2
Conceptions of Science and Hygiene	...	2	Gymnastics—half-hour daily.		
Drawing and Geometry	4	4	Totals ...	28	29
Lingerie	3	3			

At the end of the two years a third may follow, which will accord with one of the three sections in the following programme: –

Subjects.	3rd Year—Hours per Week. Commerce.	Practice in making— Ladies' Garments.	Practice in making— Children's Garments.
French	4	2	2
German	5	2	2
English	5	...	......
Accountancy and Calculation	5	2	2
Stenography and Type-writing . ..	2	......	... ..
Law	1	1	1
Conceptions of Science and Hygiene	1	1	1
Drawing and Geometry	2	4	4
Caligraphy	1	......	... ..
Millinery	......	......	3
Mending	1	2	2
Embroidery	2	......	3
Cutting-out and Confection of Garments	3	23	22
Cutting-out	...	5	......
Commercial Products...	3	......	......
Gymnastics	2	2	2
	37	44	44

As seen, this programme has three sections, one for commercial instruction and two which are known as apprenticeship divisions—"*sections d'apprentissage.*"

6. *Details of Courses in the General, Professional, and House-keeping School.*—The details of the various courses are taken as follows:—

FIRST YEAR.

French.—Three hours. Recapitulation by means of exercises of the most ordinary rules of grammar. Reading of a certain number of selections from good authors, with comments on the orthography and signification of words, the construction of phrases, and style. Redaction, composition, correspondence. Elocutionary exercises.

The instruction in the mother-tongue is kept in constant touch with the various lessons of the school. The subjects of conversation and redaction should be in close relationship with the matter of the lessons.

German.—Three hours. Exercises of conversation with the help of pictures and objects. Study of the most frequently occurring grammatical expressions and forms. Composition of simple phrases. Readings.

The instruction is above all practical. It is limited to the most indispensable grammatical ideas, and lays special stress on the expressions which are in daily use.

Accountancy and Calculation.—Two hours. Recapitulation of the metric system. Calculation by practical processes of decimal and mixed numbers. Personal and domestic book-keeping, invoices, etc.

The exercises of calculation are borrowed from the exigencies of practical life.

Commercial Book-keeping.—One hour. Elementary ideas concerning commerce and the operations appertaining thereto. Principles of book-keeping. Commercial books, waste-book, cash-book, day-book, ledger, etc. The prescriptions of the Federal code of obligations as to commercial effects.

Commercial Geography. –One hour. Switzerland: Recapitulation of physical and political geography. Climate, agriculture, and industry. Railways. Internal and external commerce. Principal places of industry and commerce. Places of production of the following alimentary commodities: –Cereals, sugar, coffee, tea, cacao, spices, edible oil, beer, wine, alcohol, cattle, meat, fish, butter, cheese, eggs, etc.

The most essential ideas concerning the nature and preparation of these various commodities will be given.

Domestic Economy.—Two hours. Duties of the young girl toward herself, her family, the school. Principles which should guide a mistress of a home. The home—selection of apartments. Maintenance—cleanliness, aëration. Furniture, selection of furniture, care of same. Garments, lingerie, various textures. Lighting and firing. Alimentation.

Drawing.—Four hours. Geometry; rapid recapitulation of the primary school programme. Sixth year: Solids, plan, elevation, section. Development and free perspective. Reduction to the scale. Side elevations of industrial ornamentation of woven forms. Application of the same plant to the ornamentation of objects selected in the furniture and in the interior decoration of the house, to embroideries, laces, and various fabrics. Reduced construction of one of the objects studied in development and free perspective.

Gymnastics.—Four lessons of one half hour. Rational gymnastics. Methodical exercises. Running and jumping. Various marches and roundelays with songs. Games. Dances.

The gymnastic lessons are obligatory, unless pupils are provided with a medical certificate declaring exemption to be necessary.

Practical

Practical Work.—Cutting-out and making up of linen articles, three hours per week. Cutting-out and confection of garments, two hours. Washing and ironing, two hours. Mending, two hours. Cooking, two hours.

Each division spends a week continuously in the kitchen. The lessons in cookery are given daily, Thursday excepted, from 9 to 2 o'clock. The lessons in ironing are given daily, from 9 to 11 o'clock.

SECOND YEAR.

French.—Two hours. Continuation and development of the programme of the 1st year. Study, by means of analysis, of the construction of the phrase. Exercises in redaction. Correspondence. Reading of a certain number of selections from the best authors, with biographical notices and comments on the style and general ideas of these authors.

German.—Three hours. Readings, conversational exercises, redaction, correspondence, compound phrases, principal and and subordinate statements, relative pronouns, conjunctions, study of the most usual irregular verbs, of separable verbs.

Arithmetic.—One hour. Development of the programme of the 1st year. Aliquot parts. Rules of mixture in simple cases. Calculation of percentages. Oral exercises and problems bearing on commerce and industry.

Accountancy.—Two hours. Keeping of books by double entry. Writing up the operations of a mercantile establishment. Waste-book, day-book, cash-book, ledger, etc., receipts and payments, audit-balance, inventory, balance-sheet, account-current. The most essential prescriptions of the code of obligations. Application to book-keeping of the various kinds of writing.

Commercial Geography.—One hour. Places of production of raw materials and manufactures. Minerals. Combustibles: coal, petroleum. Precious and common metals. Diamonds and precious stones. Vegetable products. Cotton and cotton cloths. Flax and cloth. Hemp, jute, alfa, etc. Wood. Vegetable dyes. Oils. Gums. Paper. Animal products. Wools and cloth. Raw silk and silk goods. Oils and animal fats. Skins. Sponges. Pearls. Places of production of the principal medicinal drugs. Ways of international communications. The most important railway lines and packet-boat lines. Principal markets of Swiss industry.

Hygiene.—One hour. The different parts of the human body. Skeleton. Muscles. Nerves. The sense-organs. Digestion. Circulation. Respiration. Notions of hygiene.

Science.—One hour. Levers, balances, fall of bodies, density, areometers, barometers: applications of atmospheric pressure, dilatation of solids, liquids and bases, thermometers. Fusion and dissolution: artificial glaciers. Ebullition, evaporation, conductibility, radiation, absorptive power, power of emission, with their numerous applications to domestic economy.

Zoology.—Principal useful and noxious animals.

Domestic Economy.—One hour. Development of the programme of the 1st year. Drawing, four hours. Recapitulation and development of the programme of the 1st year. Decoration applied to garments, furniture, to the internal arrangement of the house, etc., etc. Principles relative to the proportions of the human figure. Primary colours, gradation of tints, harmony. Shadings assuming the parallelism of rays; composition.

Gymnastics.—Four lessons of one half-hour per week. Development of the programme of the 1st year.

Practical Work.—Cutting-out and making up linen articles, three hours. Cutting-out and confection of garments, four hours. Embroidery, one hour. Mending, one hour. Washing, cleaning, ironing, two hours. Cooking, two hours.

Commercial Section.—The subjects in detail are:—

French.—Four hours. Recapitulation of grammar with the assistance of practical exercises. Correction of inelegant expressions. Conversations on subjects relating to commerce and industry. Redactions. Correspondence. Reading of a prescribed number of selections from the best authors.

German.—Five hours. (Exclusive use of the German language during the lesson). Varied exercises of conversation and redaction (practical subjects.) Social and commercial letters. Study of the most important grammatical rules with the help of reading.

English.—Five hours. Elements of the language (numbers, days, months, the hour, the four operations, English money). Exercises in pronunciation. Object lessons accompanied by pictures. Some exercises of oral translation and elementary grammar, application of the rules by examples. Principal irregular verbs. Study of idioms.

Accountancy and Commercial Bureau.—Five hours. Establishment of a mercantile establishment, waste-book, day-book, ledger, debit-book, cash-book. Formation of the social capital, purchases, sale, inventory, net cost, correspondence.

Merchandise Course.—Three hours. Saccharine matters and spirituous liquors. Sugars in general. General ideas on spirituous liquors: Beer, wine, alcohol, vinegar. Milk. Cheese. Colonial commodities. Spices and aromatics. Feculent and amylaceous substances. Eggs, meat, flocks. Textiles of animal origin. Textiles of vegetable origin. Dyes: Impression, mordants.

Law.—One hour. Elementary ideas on the principal points of civil law: Persons, nationality, civil-state, domicile, absence, minority, tutelage, enfranchisement, adoption. Marriage, marital authority, paternal sway, régime of property, divorce. Distinction of property. Property and its dismemberment. More detailed ideas on the law of obligations; obligations and their proof. Principal contracts, surrender, security and mortgage, sale, renting, loan, mandate, representation, commission, transport, depôt, security. Commerce, scale of commerce, societies, law of exchange, insurances. Prosecution for debts and bankruptcy.

Drawing.—Two hours. Rapid sketch of objects selected from commerce and industry. Composition and arrangement of shop windows and fronts of warehouses. Harmony of the forms and colours. Composition and decorative title of invoices and commercial letters, etc.

Caligraphy.—One hour. Recapitulation of English writing. Study of round and Gothic handwritings. Heads of accounts.

Stenography.—Two hours. Commercial stenography and practice on the type-writer.

Cutting-out and Confection of Garments.—Three hours. Pattern, cutting-out and confection of a costume, both skirt and bodice, collar, jacket or figaro.

Mending.—One hour. Renovating and transforming garments. Mending clean linen.

Embroidery.—Two hours. English embroidery, Richelieu imitation. Bulgarian embroidery, application to tulle. Grand floral monogram may be applied in fancy work. A work to be selected by the pupils.

Gymnastics.—Two hours.

Hygiene.—One hour. Clothing. Care of the body. Exercise and rest. Air and the various climates. Water. The soil. Habitation. Hygiene of towns and countries. Microbes and disinfection. Alimentation. Hygiene according to age. Hygiene according to profession.

First-Aid Course.—First-aid in cases of accident, of unexpected diseases, etc. Bandages. Dressing of wounds. Care to be given to diseases in general. Care to be given to children.

The Appenticeship Section.

French.—Two hours. Recapitulation of the principal rules by means of reading or dictation. Social letters, commercial letters.

German.—Two hours. Instruction in German on essentially practical subjects. The costume of woman. The kitchen; the market; the mercery warehouse and grocery shop; the young girl in the paternal home and in the workshop.

Accountancy.—Two hours. Establishment of a mercantile establishment, waste-book, day-book, ledger, debit book, cash-book. Formation of the social capital. Purchases, sales, inventory. Net cost. Correspondence.

Hygiene.—One hour. Garment. Bodily attention. Exercise and rest. The air and climates. Water. Soil. Habitation. Hygiene of towns and countries. Microbes and disinfection. Alimentation. Hygiene according to age. Hygiene according to profession.

First-Aid Course.—First-aid in cases of accident, of unexpected diseases, etc. Bandages, dressing of wounds, etc. Care to be given to diseases in general. Care to be given to children.

Law.—One hour. Elementary ideas on the principal points of civil law. Persons, nationality, état-civil, domicile, absence, minority, tutelage, emancipation, adoption. Marriage, marital authority, paternal sway, régime of property, divorce. Distinction of goods, property and its alienation. More detailed ideas on the law of obligations; obligations and their proof. Principal contracts. Surrender, pledge and mortgage, sale, hiring, loan, cheque, representation, commission, transport, trust, security. Commerce, register of commerce, societies, law of exchange, insurances. Prosecution for debts and bankruptcy.

Drawing.—Four hours. Patterns: Side sketches; re-arrangement of these sketches to scale and in breadth of execution, modifications according to measurements. Trimming of the garment. Laces, braids, ribbons, bands, cords, plaits, facings, cuffs, etc., revers, etc. Designs of costumes (historical and modern). Composition of ornaments and costumes. Colours.

Professional Courses.

Cutting-out.—Five hours. Method of taking the measurements. Tracing and cutting the patterns. Fixing. Experiments. Corrections according to the conformations. Production of varied models.

Cutting-out and Confection.—Twenty three hours.

Renovation and Transformation.—Two hours.

Millinery.—Three hours. Designing confection of millinery. Ribbon trimmings for round hats. Hoods. Babies' bonnets and frillings. Renovation of the trimmings for children's hats. Hoods and trimmed hats; veils. Round hats in straw, muslin, cambric, and various materials.

Embroidery.—Three hours. English embroidery, Richelieu, floral festoons; application on tulle; floral monogram. Embroidery on woollen material. Ornate festoons, wool or silk, "*motifs au passé*"; stitches of every description. Application of embroideries to garments.

Gymnastics.—Two hours.

In other cantons the instruction in similar schools is substantially identical.

7. *Lower Technical Schools of Berne, Switzerland.*—Among good examples of lower technical instruction seen by the Commissioners may be mentioned the Trade Schools of Berne, for mechanics, joiners, locksmiths, tinsmiths, etc. (*Fachschule für Mechaniker, Schreiner Schlosser und Spengler.*) An account will therefore be given in some detail, both of the scheme of administration and the courses.[1]

8. *General Scheme of the Apprentice School of Berne.*—The general scheme of the trade-apprenticeship schools of Berne is as described hereunder.

The instruction is given in what is known as the "*Lehrwerkstätten der Stadt Bern.*" The object, aims, and organisation of the workshops of this trade or apprenticeship school of Berne may be described as follows:—

The workshops are Communal Institutions under the superintendence of the Communal Council and are subject to the "direction" appointed by the Council.

Special means for the purpose of carrying on their work are afforded by the contributions of the Commune, the Canton, the Federation, and the proceeds of the articles manufactured in the school.

The aims of the institution are the following:—

(1) To make it possible for youths to acquire a thorough knowledge of a trade.
(2) To give young craftsmen, who, having terminated their apprenticeship, desire to develope and consolidate their knowledge, opportunity for obtaining a thorough all-round, practical, and a theoretical education as to their craft.
(3) To counteract the prevailing tendency to employ foreign labour, by placing Swiss labour on a higher plane of mechanical skill.
(4) To raise the character of artisans' work in general, by theoretical, industrial, and thorough businesslike education, and by a continuous investigation of new technical methods.

The result of this, it is held, will be an increase of public esteem for the whole body of tradesmen.

For the accomplishment of these aims the following divisions in the Institution have been established, viz.:—

(*a*) Division for Mechanics.	(*c*) Division for Locksmiths.
(*b*) „ Joiners.	(*d*) „ Tinsmiths.

The instruction aims, consequently, at imparting both practical and theoretical knowledge, since both are necessary in a thorough preparation for advanced craftsmanship.

The general regulations of the Institution are as follows:—

(1) *Duration of Apprenticeship.*—The apprenticeship is three years for pupils of all divisions. For such young craftsmen, however, who, having already completed their apprenticeship, aim at a more advanced theoretical and practical development of their craft, the duration of the courses of instruction is regulated according to the requirements of each, and gauged according to their preliminary knowledge, but in no case can it be less than one year.
(2) *Beginning and Termination of the School Year.*—The school year invariably begins and ends about the middle of April. There are periods of vacation from Christmas to the New Year, and for two weeks in summer.
(3) *Conditions of Admission.*—For admission to the various divisions, the following are the necessary requirements:—
    (*a*) The candidate must be over 15 years of age.
    (*b*) In the entrance examination, proof must be afforded of the possession of a good primary school education.
    (*c*) Bodily vigour.

Applications for entrance must be addressed to the "Direction," in writing, or orally, and must be accompanied by school and birth certificates, together with statements, in writing, from the parents or lawful guardians.

All applicants have to undergo an entrance examination, which takes place usually in March, and is advertised.

For

[1] Derived from what was seen by the Commissioners, and from the "Jahresberichte über den Betrieb der Lehrwerkstätten der Stadt Bern." Years 1896–1901

For the entrance examination the following are the requirements:—

German Language.—Ability to write an easy essay, fairly free from errors.
Arithmetic.—The four operations with whole numbers, vulgar and decimal fractions. Calculation of percentage.
Geometry.—The simple relationships between points, lines, rectilinear figures and circles. Calculation of the areas of plane figures.
Geometrical Drawing.—Handling of drawing materials, execution of simple geometrical constructions.
Freehand Drawing.—Some skill in outline-drawing from models.

Before the applicant is finally admitted, a probation of four weeks is required. An indenture of apprenticeship is concluded with the parents or lawful guardians of the candidate, expressed about as follows:—

Indenture of Apprenticeship.

Contracting Parties—The inhabitants of the Municipality of Berne, by their Committee of the Lehrwerkstätten of one part, and of the other part:—

....

Residence ....

Apprentice ....

Date of birth...

Residence ....

(1) *Duration of Apprenticeship.*—

Beginning ....

Termination .... including probationary period.

(2) *Probation.*—The duration of the probation is, as a rule, 4 weeks.

During this time each contracting party has the right to dissolve the agreement by the written consent of the other contracting parties. Apprentices who are inmates of the "Konvikt" shall pay, during the period of probation, 2 francs per day in return for comfortable board and residence.

(3) *The obligations of the Municipality* are as follows:—

(*a*) In the drafting of the programmes to aim at conducting the apprentice to a high plane of general mechanical skill.
(*b*) To render the instruction accessible to all by making it *free.*[1]
(*c*) To effect legal insurance against accidents.
(*d*) To remunerate under the conditions described hereunder, viz.:—

From each apprentice a definite amount of work is required from year to year, corresponding to his apprenticeship. When this normal quantity has been reached by him, and the work is executed in conformity with the regulations, and if, moreover, his conduct is satisfactory, he is entitled, after the lapse of the first six months of his apprenticeship, to remuneration.

The proportion of this remuneration is regulated according to tariff-rates, and depends on the average marks of the apprentices.

The remuneration is dispensed at the end of every month in the following manner:—50 to 75 per cent. is paid in cash, the balance, on the other hand, is kept back and deposited in a Savings Bank to the credit of the apprentice, to be handed over to him at the termination of his apprenticeship; or in order to equalise the claims of the workshop, it can be placed to their account as a guarantee of the good conduct of the apprentices.

(4) *Obligations of the Apprentices, their Parents, or lawful Guardians*:—

(*a*) Implicit obedience as regards all superiors in office, and strict adherence to the regulations pertaining to the workshops, and other regulations.
(*b*) Good behaviour—both in and outside the workshop. Punctuality, diligence and attention in relation to all duties. Neatness. The advancement to the utmost of the interests of the workshops.
(*c*) The expenses of nursing, in cases of temporary sickness, are defrayed by the Institution, but in other cases, by the apprentices themselves, according to the circumstances of parents or lawful guardians.
(*d*) In so far as no additional agreements are entered into, as in paragraphs (5) and (10) hereinafter, the cost of maintenance, clothing, and washing is likewise charged against the apprentices, making allowance for the circumstances of parents or guardians.
(*e*) Should at any time trouble occur to an apprentice, or prejudicial influences be brought to bear upon him as the result of his association with a Union ("Verein"), the Committee may grant the apprentice the privilege of dissolving his connection with the Union in question. Students who are inmates of the "Konvikt" require the sanction of the Principal thereof before joining a Union.
(*f*) Parents or guardians are required to enforce the fulfilment by the apprentices of the demands on them.

(5) "*Konvikt.*"—The "Konvikt" embraces: board, lodging, sick-nursing and general supervision. Washing is not generally included.

With his entrance into the "Konvikt" the apprentice pledges himself to conform to the household regulations in all sections. The expenses for the "Konvikt" amount monthly to Fr.........., which amount must be paid quarterly.

Continuation of residence in the "Konvikt" is concomitant as a rule with the duration of apprenticeship. The Workshops' Committee, as well as the lawful representatives of the apprentices, are entitled, however, to require the dismissal of the same from the "Konvikt" before the expiration of the term of apprenticeship agreed upon. But the granting of these requests may only ensue on the declaration of the reasons, and a month's notice.

(6)

[1] Attention is specially called to this.

(6) *Dissolution of the Compact.*—The indentures of an apprentice may, on the part of the Workshops' Committee, be dissolved at any time in the following instances :—

(1) Such ill-health of the apprentices as must interfere with the efficient performance of their duties, or sicknesses of a contagious nature.
(2) In flagrant cases of transgressions against the written agreement and regulations of the Institution.
(3) In cases of oft-repeated slight offences against the written stipulations and regulations of the Institution.

In cases of this nature the following is the procedure :—Should an apprentice commit a breach of discipline and order, he is summoned to appear before the "Direction," which reproaches him for the wrong he has done, and reminds him of the respect due to his principals, and that he must strictly observe the rules of discipline. The parents or guardians are made acquainted with the fact of the censure by letter. It is also entered into a counter-register against the apprentice to whom the warning has been administered, and is signed by him. Should a third warning of this nature prove of no avail, the Workshops' Committee requests his dismissal.

(7) *Indemnification.*—The obligation is laid upon the pupil, his parents, or lawful guardians, to indemnify in the following circumstances :—

(i) If the apprentice, through neglect of the prescribed regulations, through wanton or careless destruction of the furniture or materials, damages the Institution.
(ii) If he has to be expelled from the Institution for the reasons stated in Section (6).
(iii) If he should leave the Institution before the consummation of his term of apprenticeship.

In the case of (i) the amount of the indemnification may be reckoned in proportion to the damages committed. In the cases of (ii) and (iii) the following are the amounts demanded by way of indemnification :—Fr. 100, if the dissolution of the conditions take place during the first year of apprenticeship; if, during the second year, fr. 200; and fr. 300 if the conditions are dissolved during the third year (say £4, £8, £12 respectively).

(8) *Certificates.*—After the expiration of the required term of apprenticeship, certificates are delivered to the apprentices.

(9) *Settlement of Disputes.*—Disputes arising between the Institution and the parents or lawful guardians of the apprentices are legally settled by a Court of Arbitration, consisting of three men. Each party selects an arbiter. If the parties cannot come to an amicable settlement, the President of the Court of Justice of Berne is appealed to, and finally decides.

(10) *Special Agreements.*—Attendance at the Evening Courses of the Trade and Industrial Schools is obligatory on apprentices. The courses to be decided upon are stipulated by the "Direction" of the Workshops.

School Fees.—The instruction is free; the necessary drawing materials (case of mathematical instruments, drawing-ruler, protractor, squares and scales) are provided by the pupils themselves.

For the results of his labour, remuneration is paid the apprentice of the second half of the first year of apprenticeship, according to Section (3–*d*) of the indentures, the allotment and amount of which, dependent on their average monthly marks, are regulated according to the tariff-rates. For really good execution, the following are the rates of payment :—

(i) In the second half of the first year, 25 centimes per day.
(ii) In the second year, 50 centimes per day.
(iii) In the third year, 75 centimes per day.

"*Konvikt.*"—For the purpose of affording a home to orphans, or pupils not residing with their parents, or who have come from abroad, a "Konvikt" is associated with the Institution. The food, without being luxurious, is good, appetising, and abundant. The following is the usual menu :—

(*a*) Morning: Coffee, milk, bread and cheese or butter.
(*b*) Midday: Soup, meat, vegetables, and bread.
(*c*) Evening: Soup, meat and bread, or coffeee, milk, eggs, or farinaceous food and bread.

Besides this, each apprentice takes bread, morning and midday, to the workshop.
The expenses of the "Konvikt" amount to 50 fr. (£2) monthly.

9. *Administrative Authorities, Apprenticeship School of Berne.*—The "Lehrwerkstätten" of Berne are governed by the following authorities, viz. :—

(*a*) Direction of Internal Affairs of the Canton.
(*b*) Municipal "School-Direction" (Städtische Schuldirektion).
(*c*) A Supervising Committee, consisting of a President, a Vice-President, Secretary, and about eleven Members.
(*d*) The Director and other officers.

The school is immediately under the control of the last named, who directs its affairs as a whole. The detailed staff is as follows :—

Mechanical Division.—Technical Superintendent ("Technischer Vorsteher") and one Instructor.
Joinery Division.—Technical Superintendent, Overseer of Materials, three General Instructors, one Turner.
Locksmithing Division.—Technical Superintendent, three Instructors.
Tinsmithing Division.—Technical Superintendent, two Instructors.

Besides the above there are, one book-keeper, one saleswoman, one attendant, one superintendent of the "Konvikt."

10.

10. *Detailed Programmes of the Berne Apprenticeship School.*—The following details will enable the reader to understand the relation between the theoretical and practical portions of the instruction :—

A.—MECHANICAL DIVISION.

1st Year.

Theoretical Instruction.

Arithmetic.—Recapitulation of the four fundamental operations with whole, ordinary, and indeterminate numbers, with vulgar and decimal fractions, etc.; weights, measures, and currencies ; calculation of percentages and interest, etc.

Commercial Course.—The forms of address in letters, mails and despatches, money orders, customs duty, the despatch of goods by rail, preparation of bills of lading, receipts, accounts, promissory notes, withdrawals, practice in round-hand writing.[1]

Planimetry.—Lines, angles, triangles, quadrilaterals and polygons, circles, computation of perimeters and areas of plane figures, solution of practical problems.

Algebra.—Equations of the 1st degree with one unknown, extracting the square and cube root with ordinary numbers, equations of the 2nd degree with one unknown, equations of the 1st degree with several unknowns.

Projection Drawing.—Construction of the oval, the ellipse, hyperbola, parabola, cycloid, epicycloid, hypocycloid, evolute of the circle, elements of the theory of projection, projection of points, lines, areas and solids, spiral lines and ruled surfaces, section lines and interpenetration of solids.

Freehand Drawing.—Sketching of screws, bolts, bearings, parts of machines, etc., from models to scale.

Workshop Instruction.

Exercises in filing, turning, planing, smithing and tempering, making the details of implements and machine tools.

2nd Year.

Theoretical Instruction.

Technology.—Iron—the foreign ingredients of iron and their effect on its qualities, description of pig-iron, management and production of the smelting furnace, the iron foundry, description of malleable castings, manufacture of iron and steel, openhearth furnace, puddling, the Bessemer and Siemens-Martin processes, etc., sheet iron. Other metals—copper, lead, tin, zinc, aluminium. Alloys—brass, bronze, aluminium alloys.

Mechanics.—The most important kinds of motion, the fundamental principles of inertia, and of action and re-action, conception of force, the fundamental principles of acceleration, mass, work of moving bodies, the fundamental law as to the indifference of motion, composition and decomposition of forces, forces in a plane acting at various points, statical moment, force-couples.

Drawing.—Preparation of workshop drawings of details and complete drawings for gear, parallel screw, planing machines, turning-lathes and machine tools.

Workshop Instruction.

Manufacture of a complete machine and apparatus, passing through every stage of the work, manufacture of small tools, shearing machine, drilling machine, switch-board for currents of high potential, planing machines, turning-lathes, installation of a workshop.

B.—JOINERY DIVISION.

1st Year.

Theoretical Instruction.

The courses in *arithmetic, commerce and planimetry*, are identical with those of the Mechanical Division.

Professional Drawing.—Scarfing, dovetailing, and joints generally, and such other drawing of technical work which an apprentice has made in regular succession at the joiner's bench, exercises in projection-drawing from models and designs in conformity with indications written up on the blackboard.

Freehand Drawing.—Drawing from objects and models, drawing of outlines, in water-colours, sketching in simple colour-tones.

Workshop Instruction.

Manual exercises in planing, sawing, joining (mortise and tenons), cutting away, chiselling, etc., the construction of small models of various types of joint, making complete simple furniture in soft wood of natural colours, or stained and varnished, etc.

2nd Year.

Theoretical Instruction.

Arithmetic.—Explanation of the principles to be followed in the calculation of industrial production, estimates of furniture and works of construction from workshop designs and plans.

Stereometry.—Solids, and the computation of their areas and volumes.

Professional Drawing.—Exercises in sketching of furniture from a geometrical and perspective point of view, architectural drawing.

Freehand Drawing.—Drawing of ornaments and theory of shading.

Workshop Instruction.

Beginning of the massive work in hardwoods, chiefly of oak chairs and chests, passing on then to their complete construction.

---

[1] The angular writing of Germans in German characters is replaced by round-hand in ordinary characters.

WORK SEEN IN THE APPRENTICE-SGHOOL OF BERNE, SWITZERLAND.

WORK SEEN IN THE APPRENTICE-SCHOOL OF BERNE, SWITZERLAND

3RD YEAR.

Theoretical Instruction.

Book-keeping.—Instruction concerning the object and arrangement of and the keeping of special books for the purposes of trade. The carrying on of a business by settlement of accounts, the yearly balance, etc. Brief explanation of bills-of-exchange, bankruptcy and prosecution, composition of business letters.

Professional Drawing.—Theory of architectural forms with application. Designing of a single piece of furniture, and also the whole of the furniture for a room, in modern and also in antique style.

Freehand Drawing.—Group of coloured intarsia and plastic ornaments with application from plants.

Workshop Instruction.

Working in walnut wood, lightly and completely polished.

C.—LOCKSMITH'S DIVISION.

1ST YEAR.

Theoretical Instruction.

The *Arithmetic*, *Commercial matters*, and *Planimetry* are identical with those of the preceding divisions.

Drawing—In the preparatory course, drawing in projection of simple objects, as rivets, screws, etc. Ornamental drawing from simple models, the course being much the same as that previously indicated.

Working Instruction.

Rudimentary exercises in filing, chiselling, of simple metal-work, as ventilators, fire escape doors, knobs, etc. For the fire-place: Forging of fenders, chiselling, drilling, etc.

2ND YEAR.

Theoretical Instruction.

Arithmetic.—Explanation of the principles to be followed in the calculations of industrial production. Estimation of locksmith's work from workshop drawings and sketches.

Technology.—Extraction and preparation of iron, steel, tin, zinc, copper and lead. Alloys.

Stereometry.—Solids, and the calculation of their surfaces and volumes.

Drawing.—Volutes, etc., various locks, simple constructions such as windows, doors, etc., from sketches, drawing from plaster models, use of charcoal, crayons, colour, simple ornamentation.

Workshop Instruction.

Work in the construction of fastenings, and simple spiral ornaments. Chiselling, filing and hammering out leaves, flowers, etc. Construction of bar-locks.

3RD YEAR.

Theoretical Instruction.

The *Book-keeping* is identical with that of the 3rd year of the preceding division

Drawing.—Construction drawing. Exercises in sketching of works of large extent, such as glass roofs, pavilions, green-houses and the making of accurate designs of details. Ornamental drawing. Details of the more extensive locksmithing work from photographs in charcoal and colours. Instruction in the designing of simple details of doors, etc.

Workshop Instruction.

Forging of simple objects of industrial art. Carrying out of the decorative details of doors, fanlight, balustrades, etc.

D.—TINSMITHING DIVISION.

1ST YEAR.

Theoretical Instruction.

Arithmetic.—Recapitulation of the four kinds of fundamental operations with whole, concrete and literal numbers. Arithmetic with vulgar and decimal fractions. Calculation of percentages and interest.

Commercial Knowledge and *Planimetry* are the same as in the other divisions

Projection Drawing.—Constructions in plane surfaces. Projections of cubes, pyramids, cylinders and cones. Drawing of architectural members and mouldings.

Freehand Drawing.—Drawing of simple flat ornaments from objects. Neat and accurate drawings in outline from objects. Contours, etc., with water colours, sketching in simple colour-tones.

Workshop Instruction.

Making of simple household objects, paying special consideration to manual labour. Exercises in cutting out, arrangement of the wires, rounding off, soldering, designing and drawing, bending, curving, smoothing, and embossing.

2ND YEAR.

Theoretical Instruction.

Arithmetic.—Explanation of the principles to be followed in the calculation of industrial productions. Estimates for tinsmiths' work from sketches and plans of construction.

Technology.—Extraction and manufacture of iron, steel, tin, zinc, copper and lead. Alloys.

Stereometry.—Solids, and the computation of their areas and volumes.

Projection and Professional Drawing.—Drawing and development of solids. Plane sections of pyramid and cone. Oval and oblique cones. Transitions with applications to practical work. Cornices, letters with shading construction. Execution in paper and in zinc.

Freehand Drawing.—Representation of neat drawings in outline of finials, weather-cocks, etc., from models. Drawing from zinc models with extensive application of colour-tones.

Workshop

Workshop Instruction.

Work on a larger scale from tin-plate, zinc, and copper, combined with the employment of machines. Instruction in hard soldering. Installation of gas and water-pipes. Exercises in the fixing of connections and in the curving of iron and lead pipes. Manipulation of various plans for gas and water-pipes. Bath fittings. Practical performance of such works of construction.

3RD YEAR.

Theoretical Instruction.

The *Book-keeping* is identical with that of the other divisions.

Architectural Drawing.—Explanation of the construction of guttering, down-pipes, etc. Treatment with various types of roof. Designing of the principal constructions in parallel perspective.

Opportunity will be given the pupils to attend the evening courses for modelling in the "Art Industrial" School (*Kunstgewerbeschule*).

Workshop Instruction.

The making of bath-tubs of the most various construction for plunge, hip, foot, and standing baths, of gas-heaters, copper models, ornamental zinc work, and practice in trap-work. Styles, casts, and moulds of cornices for windows, of decorations and copings. Works of construction, including roofs, sewers and private cabinets, stove-pipes, gas and bath fittings, together with the relative repairs thereof.

The above gives a fairly complete account of the general work of these schools. The fitting-up of the school, the equipment, and the work turned out were very artistic.

A feature worthy of remark is the number of gifts received by the institution. During the year 1901 the following were acknowledged:—

From the Swiss Department of Industry: Drawing-books and books of professional instruction.

From the Direction of Internal Affairs of the Canton of Berne: Two copies of the "Special Report of the Paris International Exhibition of 1900."

From private donors: Free copies of the "Gewerbe," and 28 volumes of professional literature.

11. "*Technikum*" *at Winterthur in the Canton of Zürich.*—The Technikum at Winterthur is a cantonal industrial teaching institution which aims at providing for an intermediate grade of technical education—viz., by means of theoretical and practical instruction. The grade of the work is higher than that for ordinary artisans, but is, of course, not equal to that of the University. It has the following divisions, viz.:—

(1) School for Builders; (2) for Mechanical Engineers; (3) for Workers in Mechanics of Precision; (4) for Workers in Electrotechnics; (5) for Chemists: (6) for Workers in Art-industries (*Kunstgewerbe*); (7) Surveyors; (8) Commercial School; (9) a School for those who enter the railway service.

Pupils must be over 15 years of age, and must have passed through what is known in Switzerland as a secondary school; a district school (*Bezirksschule*), a "*Realschule*," or the corresponding classes of a higher middle school.

The schools for mechanical engineers, chemists, surveyors, and those who work in electrotechnics, consist of six half-year courses; the school for builders and art-industries of five half-year courses; those for mechanics of precision and for the railway service, of four half-year courses.

Not more than thirty scholars are allowed in a single class; and when this number is exceeded, parallel classes are formed. The summer course begins in April and the winter in October, there being vacations of two weeks in the former and seven weeks in the latter; the Christmas holidays lasting also two weeks. In the last week of the semesters there is a public recapitulation and examination to determine the progress in the various branches of work. The programme of the *Technikum* is fixed by the Educational Council and the Supervising Committee.

12. *Equipment of the Winterthur* "*Technikum.*"—The material equipment of the "Technikum" at the time of the visit of the Commissioners was excellent, and was being rapidly added to. It consists of the following collections, viz.:—

(1) Collection of physical apparatus; (2) of building materials; (3) of architectural models and models of importance to the builder; (4) Models of parts of machines and of mechanical devices for engineers; (5) A general technological collection; (6) Collection for instruction in spinning and weaving; (7) Apparatus and instruments for mechanics of precision; (8) Electro-technical apparatus and instruments; (9) Samples of the products of chemical industries; (10) Mechanical apparatus and preparations; (11) Mineralogical and geological collections; (12) Collection of plaster casts; (13) Collection for freehand and professional drawing in the *Kunstgewerbeschule*; (14) Collection of the apparatus and instruments of the surveying school: (15) Geographical and ethnographical collection; (16) Collection of teaching-material for the commercial school; (17) Collection of teaching material for those who wish to enter the railway service.

Every teacher is required to keep the apparatus and instruments in his own cabinet in good order, and to keep a complete inventory of the same; and, where one collection is used by several teachers, the Supervising Committee assign the responsibility.

There is a fine library in connection with the school.

13. *General Organisation of the Winterthur* "*Technikum.*"—The Director of the Institution is its supreme head, and is appointed on the recommendation of the Supervising Committee (*Aufsichtskommission*) and the Educational Council (*Erziehungsrat*), from the teaching body; he must have served thereon three years. He must not teach on the maximum more than 12 hours a week, and is charged with the oversight of the whole Institution and with the maintenance of its efficiency. He attends to the following matters:—

(*a*) Complete list of the regular and occasional pupils, their residence, semester-marks, etc.
(*b*) Preparation of the semestral and leading certificates.
(*c*) The general expenses, and in general, the detailed budget of the Institution.
(*d*) Inventory of the furniture of the school.
(*e*) Cases of sickness and accident.
(*f*) The semestral public reports concerning the Institution.
(*g*) The general affairs of the library.

The

The Supervising Committee.—The "*Aufsichtskommission*" of the *Technikum* consists of the Director of Education as President, and ten Councillors of the Government (*Regierungsrate*) are elected on the recommendation of the Educational "Direction," four being residents of the town of Winterthur. Their function is to maintain a general oversight of the affairs of the Institution.

Convention of Teachers ("*Lehrerkonvent*").—The teachers of the Institution, as a whole, constitute a "Convention," the President of which Convention is the Director of the Institution. The function of the Convention is similar to that of a Faculty in a University. It discusses the necessary co-ordination of the instruction in the classes, the methodical treatment of the material of instruction as a whole, and deals with the question of its general plan, the constitution of parallel classes, etc.

By the vote of the sittings of the Convention, the assistant teachers may be asked to be present so as to give the benefit of their advice.

The Teaching-Staff.—The members of the teaching staff are generally appointed technically for a period of six years, but really permanently. A teacher may be appointed to deal with a group of cognate subjects, but not for the whole teaching in any one department of the school—that is to say, no teacher may take the whole of electro-technics, the whole of chemistry, or the whole teaching in the commercial school.

Each teacher is required to contribute to the Cantonal Insurance scheme for the benefit of the widows and orphans of the clergy and teachers, and after thirty years' school service every teacher can enter on the enjoyment of a pension for the remainder of his days.

Students.—These are of two kinds, regular (*Schüler*) and irregular (*Hospitanten*). Regular pupils must attend all the subjects in their particular faculty, except in cases where special exception is made. They may, however, attend other subjects. Both may be of either sex, and entrance as a rule must commence at the beginning of a Semester, but may be allowed at other times under special circumstances. They are required to produce certificate of birth, a certificate from the father or guardian, the certificates of their school career, a certificate as to moral character, either from their last school or from the Civil Magistracy. Occasional students must produce certificate of birth and present trade occupation.

For entrance to the first class the age should not be less than 15 years, and to the other classes the corresponding ages. Students enter by passing an examination, and their acceptance becomes definitive after a probationary period of three months. Every pupil is required to join a special organisation for sickness and accidents. The school fees are the same for citizens of Switzerland and for the sons of Swiss dwelling in foreign countries—30 francs per semester. In the chemical school, 20 francs are also paid for the use of apparatus, etc., and in the electro-technical school 10 francs per semester. Occasional students pay 2 francs per weekly-hour of instruction.

14. *Details of the Courses.*—It will, perhaps, suffice to give details of three of the courses of this school, and for this purpose the course in electro-technics, that for the railway service, and the survey course, may be taken. The other courses would not differ materially from similar courses in German institutions of the same grade, and a mere statement of the courses will be sufficient in the form of programmes.

The programme of the *School for Builders and Architects* is as follows:—

Programme of the "Schule für Bautechniker," Wintherthur.

Subject.	Class and hours per week.				
	I.	II.	III.	IV.	V.
German	3	2	...	...	...
Arithmetic	4–3	...	...	...	...
Algebra	4–3	3	...	...	...
Geometry	4–3	3	2	...	..
Descriptive geometry	...	4	4	...	...
Physics	3	3	...	...	...
Chemistry	3	3	...	...	...
Linear drawing	6	...	...	...	...
Freehand drawing	5	...	...	...	...
Perspective	...	...	...	...	2
Modelling	4	...	...		...
Caligraphy	1	...	...	...	...
Theory of building construction	...	5	7–6	7	4
Architecture	2	...	...	2	...
Theory of architectural form	...	...	4–3	...	3
Architectural drawing	5	9	10	...	..
Ornamental drawing	...	4	5	6	4
Ornamental modelling	...	...	4	3	3
Mathematics (practical)	...	2	...	...	...
Mineralogy and geology	...	2–1	...	...	...
Mechanics of building construction	...	...	...	3	...
Building material	..	...	...	2	...
Estimates	...	...	...	3	...
Designs	...	...	...	...	15
Architectural orders	...	...	...	...	3
Heating and ventilating		...	...	...	2
Water service and lighting	...	...	...	...	1
Road construction	...	...	...	...	4
Book-keeping	...	...	...	...	2
Building law	...	...	...	...	1

It is obvious that the above course is a very complete one.

The

The programme of the *School for Mechanical Engineers* is as follows :—

Programme of the "Schule für Maschinentechniker," Winterthur.

Subject.	Classes and hours per week.					
	I.	II.	III.	IV.	V.	VI.
German	3	2	...	...	...	...
Arithmetic	4	...	...	...	..	...
Algebra	5	5	3	2	...	...
Geometry	5	3	3	...	...	...
Descriptive geometry	...	6	4	...	...	...
Physics	3	5	4	...	...	...
Chemistry	3	3	...	...	...	...
Geometrical drawing and sketching	8	4	...	...	...	...
Freehand drawing	4	...	...	...	...	...
Mechanico-technical drawing	...	6	8	6	...	...
Calculations with side-rule	...	...	1	...	...	...
Mechanics	...	...	5	7	...	...
Elasticity and theory of construction	...	...	8	5	5	...
Graphical Statics	...	...	...	1	2	...
Mechanical construction (exercises)	...	...	...	10	12	18
General technology	...	...	...	2	...	...
Spinning and weaving	...	...	...	3[1]	3[1]	2[1]
Theory of machines	...	...	...	...	6	9
Electrotechnics	...	...	...	...	3	3
Surveying and hydraulics	...	...	...	...	3	...
Theory of building construction	...	...	...	...	3	...
Differential and integral calculus	...	...	...	...	4[1]	...
Workshop machinery and estimates	...	...	...	...	...	3
Chemical technology	...	...	...	...	..	2[1]
Book-keeping	...	...	...	...	...	2

This three-year course is obviously a very thorough one, and from what the Commissioners saw the work is well carried out.

The programme of the *School for Fine Mechanics* is as hereunder :—

Programme of the "Schule für Feinmechaniker," Winterthur.

Subject.	Classes and hours per week.			
	I.	II.	III.	IV.
German	3	2	...	...
Arithmetic	4	...	...	...
Algebra	4	3	5 (Algebra, Geometry and Descriptive geometry together)	...
Geometry	4	4		...
Descriptive geometry	...	4		...
Physics	3	3	...	...
Chemistry	3	3	...	...
Geometrical and technical drawing and sketching	7	12	...	...
Freehand drawing	4	..	..	..
Technical mechanics	...	3	...	...
Technology	...	2	...	...
Theory of instruments	...	...	6	6
Practical physics	...	...	6	6
Theory of construction and practical exercises	...	...	14	16
Mathematico-physical calculation	...	.	3	3
Electrotechnics	...	...	...	3
Book-keeping	...	...	...	2

[1] Optional subjects.

The

The following is the programme for those who take up Electrotechnics, the details of the courses being given later :—

Programme of the "Schule für Electrotechniker," Winterthur.

Subject.	Classes and hours per week.					
	I.	II.	III.	IV.	V.	VI.
German	3	2	...	...	...	...
Arithmetic	4	...	...	...	...	...
Algebra	5	5	3	2	...	...
Geometry	5	4	3	2	...	...
Descriptive geometry	...	6	4	...	...	...
Physics	3	5	4	...	...	...
Chemistry	3	3	2	2	...	...
Chemical laboratory	...	...	4	8	...	..
Geometrical drawing and sketching exercises... ...	8	4	...	...	...	...
Freehand drawing	4	...	...	...	...	...
Mechanico-technical drawing	...	6	7	...	...	...
Mechanics	...	...	4	6	...	...
Theory of elasticity	...	...	4	...	...	...
Theory of construction	...	...	3	4	4	...
Mechanical construction (exercises)	...	...	...	10	12	14
General technology	...	...	...	2	...	...
Electrotechnics	...	...	...	2	5	5
Differential and integral calculus	...	...	...	...	4	...
Theory of machines	...	...	...	...	6	4
Electro-technical "Praktikum"[1]	...	...	...	...	8	8
Workshop machinery	...	...		...	...	2
Higher mathematics	...	...	...	.	...	2[2]
Theory of building construction	...	...	...	...	...	2[2]
Book-keeping	...	...	...	...	...	2

The course in Chemistry is as follows :—

Programme of the "Schule für Chemiker," Winterthur.

Subject.	Classes and hours per week.					
	I.	II.	III.	IV.	V.	VI.
German	3	2	...	...	...	...
Arithmetic	4	...	...	...	...	...
Algebra	4	3	...	...	...	...
Geometry	4	4	...	...	...	...
Linear drawing	6	...	...	...	...	...
Freehand drawing	4	...	...	...	...	...
Technical drawing and sketching	...	6	...	...	..	6
Physics	3	3	4	2	2	...
Practice, physical laboratory	...	3	...	...	...	...
Inorganic chemistry	...	6	...	...	...	...
Analytical chemistry	..	1	3	1	...	...
Practice, chemical laboratory	...	10	18	16	16	21
Organic chemistry	...	...	6	6	...	...
Technical chemistry	...	...	3	3	3	3
Mineralogy and geology...	...	...	3	...	...	...
Dyes	...	...	...	6	...	...
Theory of machines	...	...	...	4	4	...
Bleaching, dyeing, printing	...	...	...	...	4	2
Practical microscopy	...	...	...	...	4	...
Agricultural chemistry	...	...	...	...	3	...
Mechanical technology of textile materials	...	...	...	...	...	2
Recapitulations	...	...	...	...	...	2
Book-keeping	...	...	...	...	...	2

The chemical laboratory is well equipped for the practical exercises to be undertaken therein. The

[1] A "Praktikum" is a working class. This could be understood as eight hours practical work in an electro-technical laboratory.

[2] Optional subjects.

The programme for the Art-Industry School is as hereunder :—

Programme of the "Schule für Kunstgewerbe" at Winterthur.

Subjects.	Classes, and Hours per Week.				
	I.	II.	III.	IV.	V.
German	3	2	...	...	...
Arithmetic	4	...	...	...	...
Linear drawing	6	...	...	...	...
Freehand drawing	20	14	14	10	14
Modelling	6	6	6	5	6
Descriptive geometry	2	...	...	...	...
Perspective	...	...	3	...	...
Architectonic drawing	...	3	4	4	...
Theory of ornamental forms	...	3	3	3	...
Professional drawing	...	10	15	18	20
Anatomy	...	...	...	1	...
Book-keeping	...	...	...	1	...
Artistic style in industry	...	...	...	...	4

Naturally, in the above course drawing plays a very important part.

The programme of the school for *surveying and agricultural technology* is developed as follows :—

Programme of the "Schule für Geometer and Kulturtechniker," Winterthur.

Subjects.	Classes, and Hours per Week.					
	I.	II.	III.	IV.	V.	VI.
German	3	3	3	......	......	......
Arithmetic	4	......	......	......	......	......
Algebra	4	4	4	3	......	......
Geometry and Analytical Geometry	4	4	3	3	......	......
Mathematical Exercises	......	2	2	4	......	......
Descriptive Geometry	......	4	4	......	......	......
Physics	3	3	3	......	......	......
Chemistry	3	3	......	......	......	......
Linear and Freehand Drawing	4+7	......	......	......	......	......
Plan and Map Drawing...	......	6	4	6	4	......
Geography	2	2	......	......	......	......
Caligraphy	1	1	......	......	......	......
Mineralogy and Petrology	......	......	2	......	......	......
Surveying and Cadastral Surveying	......	......	5	6	4	3+2
Field Surveying	......	......	4	......	10	4
Agricultural Botany	......	......	2	......	......	......
Agricultural Chemistry	......	......	......	......	3	......
Spherical Trigonometry	......	......	......	2	......	......
Mechanics of Construction	......	......	......	4	......	......
Materials of Construction	......	......	......	2	......	......
Theory of Construction	......	......	......	4	4	......
Survey Computations	......	......	......	......	2	......
French	3	3	......	......	......	......
Higher Mathematical Analysis...	......	......	......	......	4	......
Geographical Latitude and Longitude... ...	......	......	......	......	1	......
Geology	......	......	......	......	2	......
Least Squares	......	......	......	......	......	3+4
Construction of Roadways	......	......	......	......	......	2
Theoretical Hydraulics	......	......	......	......	......	2
Hydraulic Construction...	......	......	......	......	......	2
Irrigation etc.	......	......	......	......	......	4

The

The Commercial Course in the "Technikum" of Winterthur will be dealt with later in Chapter XXVIII. The programme for those who desire to enter the Railway service is as follows :—

Programme of the "Schule für Eisenbahnbeamte," at Winterthur.

Subjects.	Classes, and Hours per Week.			
	I.	II.	III.	IV.
German	5	5	4	4
French	5	4	4	4
Italian...	5	4	3	3
English	3	2	2	2
Arithmetic	3	3	2	2
Book-keeping...	1	1	......	......
Geography	3	3	2	2
Physics	3	4	......	......
Caligraphy	2	1	......	......
Stenography	3	1	......	......
Railways	......	2	......	......
Dispatching service	......	2	2	2
Railway law	......	2	2	2
Tariff	......	1	2	2
Telegraph service	......	2	......	......
Economics	......	......	2	2
Rolling stock	......	......	2	1
Signalling	......	......	2	2
Forwarding service, traffic management ...	......	......	5	5
Practical exercises	......	......	4	4
First aid	1	......	......	......

There are about 700 pupils in the "Technikum" altogether.

15. *Course in Electro-technics, Winterthur.*—The following are the details of this course, briefly stated :—

Class I (Summer)—

German—3 hours per week. Reading of prose and poetry, exercises in verbal expression, style, recapitulation of grammar.

Arithmetic—4 hours. Recapitulation and extension of the work of the Zürich Secondary School, with special regard to proportion, fractions, interest and discount, written and oral solution of problems in civil life.

Algebra—5 hours. Recapitulation of elements, 1st degree equations with several unknowns, indices and roots, square numbers and roots, with numbers and polynomial expressions.

Geometry—5 hours. Recapitulation and completion of planimetry with exercises; geometry of conic sections, stereometry, the straight line and surface in space.

Physics—2 hours. Experimental introduction, general properties of bodies, equilibrium and motion of solid, of fluid and gaseous bodies.

Chemistry—3 hours. Metalloids and their most important chemical combinations.

Linear drawing and exercises in sketching—7 hours. Geometrical construction, representation of geometrical bodies, in plan, elevation, side elevation, and section, with the help of scales and from models. Technical forms of writing. Preliminary exercises and examples from the theory of projection, from wall diagrams. Orthogonal projection without the assistance of the scale and compass.

Freehand Drawing—4 hours. Outlines from wall diagrams, simple ornamental *motifs*. Class instruction.

Caligraphy—1 hour (optional). Round writing.

Class II (Winter)—

German—2 hours. Continuation of the work of preceding class, with the exception of grammar.

Alegbra—4 hours. Theory of the equations of the 1st degree, 2nd degree, one unknown, logarithms, use of logarithmic tables, exponential equations.

Geometry—4 hours. Stereometry, intersection of three planes, solids and their calculation, plane trigonometry, solution of right-angled and oblique-angled triangles.

Descriptive Geometry—6 hours. Representation of points, straight lines, and surfaces upon two and three projection planes, position of points and straight lines upon a plane, plane system and determination of its true magnitude, representation of bodies bounded by planes and by surfaces of rotation, plane sections and their development, rotation about an axis and variations of form, graphical exercises.

Physics—5 hours. Physical mechanics, theory of heat, elements of meteorology, magnetism, frictional electricity. The course is experimental, with, however, a mathematical foundation.

Chemistry—3 hours. Most important metals, their chemical combinations; outlines of organic chemistry.

Mechanico-Technical Drawing—6 hours. Drawing of tools in the workshop, parts of machinery, apparatus, etc., from models, etc. Practice in sketching, 4 hours. Class instruction and, later, individual instruction. Sketches made in orthogonal projection without compass, etc.

Caligraphy—1 hour (optional). Round writing.

Class III.

Class III (Summer)—

Algebra—4 hours. Second degree equations to two unknowns, maxima and minima of complete and degree functions, graphical representation of such equations, arithmetical and geometrical progressions, calculation of interest and annuity.

Geometry—3 hours. Exercises in plane trigonometry, analytical geometry of the plane, rectangular and polar co-ordinates, area and plane polygons, equation of straight line, distance and angular relations between points and lines.

Descriptive Geometry—4 hours. Intersection of solid bodies. Theory of shadows, application to mechanico-technical drawing, graphical exercises.

Physics—4 hours. Galvanism, optics, experimental, the foundation being mathematical.

Chemistry—2 hours; *Chemical Laboratory*—4 hours. Preparatory work, preparation of materials that have application to electro-chemistry. Use of apparatus, reactions of solutions of metal salts. The effect of electricity with different sources of current, primary elements. Daniell, Bunsen and Lelanché elements. Secondary elements, installation of accumulators, investigation of material generally. Thermopiles.

Mechanics—4 hours. Composition and decomposition of forces. Statical moment, conditions of equilibrium, centre of gravity, sliding and rolling friction, uniform and non-uniform motion and rotation. Velocity, acceleration, mass, force, work, potential, central and pendulum motion, impact.

Theory of Elasticity—4 hours. Resistance of solids; to tension compression and shearing; to bending and crushing, and to torsion; strength of walls and vessels, general elasticity.

Theory of Construction—3 hours. Elements of machines, bolts, nuts, screws, etc.

Mechanico-technical drawing—7 hours. Drawing of instruments and simple machines from models, etc.

Class IV (Winter)—

Algebra—2 hours. Theory of combination, binomial theory for positive integral exponents, infinite series, binomial theorem, negative and fractional exponents. Exponential series, sine and cosine series. Logarithmic theory, solution of higher numerical equations by approximation methods.

Geometry—2 hours. Analytical geometry, continuation of theory of straight line, transformations, general equations to the circle and central equations of the conic sections. Discussion of the general equation of the second degree in two variables. Reductions.

Mechanics—6 hours. Equilibrium of fluids, laws of efflux, motion of water in pipes and in channels, hydraulic measurements, impact of water, measurement of work of a machine, fly-wheel and governor. Principles of the mechanical theory of heat.

Theory of Construction—4 hours. Cones, etc., axes, cylinders, shafting, spur-wheels, etc.

Exercises in Construction—10 hours. Riveted connections, cylindrical and conical screws, Transmission with belts, etc.

Technology—2 hours. General physical and chemical properties, most important metals and alloys. Soldering experiments. Conducting and insulating materials. Glass, wood, shellac, varnishes, guttapercha, ebony and other materials. Forms of material commercially available, ordinary and special sources.

Chemistry—2 hours; *Chemical Laboratory*—8 hours. Continuation of instruction of third class. Electroplating. Baths for electroplating with copper, silver, gold, nickel, etc. Determination of the materials for baths. Treatment of the articles to be electro-plated, including their subsequent polishing. Negatives in plaster, wax, gutta-percha, etc., reproduction in copper; analytical work, quantitative determination of metals by electrolysis, quantitative analysis, metals, and their most important salts.

Electro-technics—2 hours. Ohm's law, simple electric circuit, electro-motive force, potential, external and internal resistance, rheostats, Kirchhoff's laws, applications, electro-chemical phænomena, galvanic elements, accumulators.

Class V (Summer)—

Mathematics—4 hours. Leading elements of differential and integral equations with special regard to electro-technics.

Mechanical Engineering—6 hours. Theoretical and constructional discussion of pumps, turbines, steam-engines, calculation of these machines.

Theory of Construction.—4 hours. Crank-mechanism. Eccentric and similar elementary parts of machinery.

Exercises in Construction—12 hours. Windmill, pumps, turbines, etc.

Electro-technics—5 hours. Magnetic and electric potential, magnetic field of force, magnetic induction, moment of magnets, determination of the horizontal component of the earth's magnetism. The fundamental elements of electrostatics, theory of condensers. Electro-magnetism. The magnetic circuit. Conception of magnetic-resistance. Magneto-motive force, heat and light action, Joule's law, incandescent and arc lamps, induction, the electro-magnetic and electrostatic measurement. Theory and calculation of continuous current machines and continuous current motors.

Electro-technical "Praktikum"—8 hours. Fundamental measurements of resistance, current intensity, difference of potential. The technical ampère and voltmeter and their standardisation by means of compensation apparatus. Standardisation of electrical quantities. Measurement of cells, accumulators and storage batteries.

Class VI (Winter)—

Machine construction—4 hours. Boiler, gas and petroleum motor, treated from the theoretical and constructional standpoint, calculations in connection therewith.

Exercise in Construction—14 hours. Designs of turbines, steam engines and dynamos.

Electro-technics—5 hours. Technique of alternating current. Theory and computation of generators, motors, and transformers for one, two, or three phase currents. Theory and practice in connection with electrical transmission of power, and continuous and alternating currents; electric railroads. Electrical installation in buildings and in industrial establishments for power and light with continuous and alternating current. Calculations in connection with the conducting system. Discussion of individual establishments and central stations, etc. Calculations of electrical apparatus and machines.

Electro-technical "Praktikum"—8 hours. Magnetic measurements, measurement of continuous current machines and motors, alternating current machines and motors, and transformers. Measurements in connection with the installation of power and light. Photometric measurement for glow and arc lamps. General theory for ordinary workshop machines.

General theory for ordinary workshop machinery—2 hours. The tools of a workshop, their construction and action, driving by electro-motors, metal-working lathes, vertical and horizontal drilling machnes, planing-machines, punching-machines, drilling-machines, screw-cutting machines, mechanical hammers. For wood work, sawing, planing, boring, mortising machines.

Book-keeping—2 hours. Theory of single and double entry, working out of the monthly balance in a manufactory by both methods, the exchange and check system, introduction into the ideas of accounts-current.

Mathematics—2 hours, optional. Continuation of the instruction of the preceding class and exercises.

Theory of Building Construction—2 hours, optional. Introduction to the fundamental features of stone and wood construction; simple concrete examples of building for technical purposes.

It will be seen from the above outlines of the courses that the type of work is what would here be called *higher work*. At the same time it should be remembered that a still higher grade of instruction is provided in Europe for such subjects. The grade is far above that of artisan work.

An example of another division of instruction will now be taken.

16. *Course for the Railway Service at the Winterthur "Technikum."*—As previously stated, there are only four classes in this course, which was provisionally accepted on the 17th March, 1900—that is, not long before the Commissioners' visit. The details are as follow:—

Class I (Summer)—

German—5 hours; *French*—5 hours; *Italian*—5 hours. These languages are treated with special regard to facility in conversation and to technical expressions in the Railway service.

English—3 hours (optional). Conversational facility also demanded.

Arithmetic—3 hours. Special regard to proportion and questions of interest and discount. Written and oral solution of railway service problems.

Book-keeping—1 hour. Preparation of inventories, administrative calculations of every kind.

Geography—3 hours. Commercial geography of Switzerland, with special reference to its trade.

Physics—3 hours. Mechanics of solids, fluids, and gaseous bodies, acoustics, heat.

Caligraphy—2 hours. Writing in German characters and in Latin (ordinary) character.

Stenography—3 hours. System Stolze-Schrey.

First Aid—1 hour. Anatomy and physiology of the human body; wounds, bandaging material and its use, practical exercises.

Class II (Winter)—

German—5 hours. Classical prose works; exercises in oral expression, style, correspondence.

French—4 hours; *Italian*—4 hours; *English*—2 hours (optional). In continuation of the preceding.

Arithmetic—3 hours. Continuation of preceding class. Calculations in connection with the noble metals and currencies. Theory of accounts-current. Solution of simple examples in various kinds of reckoning. Calculation of exchanges, mental arithmetic.

Book-keeping—1 hour. Single and double entry, and its applications.

Geography—3 hours. Commercial geography of Europe, with special regard to trade.

Physics—4 hours; Magnetism, Electricity, Optics—3 hours. Fundamental elements of electro-technics, with special regard to telegraphic and telephonic systems—1 hour.

Caligraphy—1 hour; *Stenography*—1 hour.

Railroad Installation—2 hours. General idea and details of railways, the road station buildings, etc., crossings, railroad excursions, expedition service—2 hours. Transport of persons, official forms, tickets, their control, sale, etc., special transport, accountancy.

Railway Law—2 hours. Federal law, the construction and management of railways throughout the federated cantons. Switzerland, normal concessions, federal laws concerning the duties of railways and steamship services in regard to the killed and wounded. The laws in connection with accidents, injuries, etc., received on the railways. Federal laws concerning railway police and concerning the transport on railways.

Tariffs—1 hour. Railway tariffs, various kinds. Directions concerning normal concessions, tariff in regard to persons, general and special regulations.

Telegraphic Services—2 hours. Telegraphy in the railway service, learning the alphabet, receipt and despatch of messages. Exercises in seeking out the cause of and dealing with interruptions. General rules regarding the telegraphic service.

Class II (Summer)—

German—4 hours; *French*—4 hours; *Italian*—3 hours; *English*—2 hours (optional). The instruction is given in several languages. The great epic and lyric poets are read in German. The practical work deals with correspondence in all the languages mentioned.

Arithmetic—2 hours. Theory of accounts-current, exchange reductions, calculations in connection with goods, mental arithmetic.

Geography—2 hours. Commercial geography in America and Africa, graphical representation of statical information.

Economics—2 hours. The idea of value, goods, economy, national economy, theory of production with special regard to national industrial power, capital, and the distribution of labour.

Rolling Stock—2 hours. General, steam, and electricity, locomotives, carriages, brakes, excursions to railway stations and electrical works.

Railway Signalling—2 hours. Aim and purpose of signals, various kinds, signals at stations, on the line, excursions to railway stations.

Forwarding Service—5 hours. Station service, general time-tables, graphical time-table, transport of cattle, train numbers, shunting and signal service, truck service, sidings.

Despatch Service—2 hours. Transport of baggage, transport by express, railway.

Railway Law—2 hours. Transport rules of the Swiss railways.

Tariffs—2 hours. Swiss luggage tariff, tariff for the transport of the sick, of corpses, and living animals.

Practical Exercises—4 hours. Preparation of reports, exercises in regard to personal and luggage tariff, and tariffs of invalids, etc.

Class IV (Winter)—

German—4 hours; *French*—4 hours; *Italian*—3 hours; *English*—2 hours (optional). These include lessons in railway correspondence.

Arithmetic—2 hours. Practical forms of calculation.

Geography—2 hours. Commercial geography of Asia and Australia, recapitulation.

Economics—Theory of trade, price measure and weight, money and currency, credit and bank systems, transport, distribution of wealth, wages, capital and interest thereon. Contractor's profits, ground rent, consumption of goods.

Rolling Stock—1 hour. Construction, manufacture and maintenance of carriages for persons' luggage and goods in connection with Swiss trade. Instruction concerning returns and entry returns on foreign goods' trucks, excursions to stations.

Signalling—2 hours. Signalling trains, signalling rules, and common regulations in the signalling service of the Swiss railways; practice.

Despatching Service—5 hours. Despatch service, railway service proper, traffic service, service for care of stations and railways.

Expedition Service—2 hours. Transport of the military, of goods, of the sick and corpses, of living animals; accountancy.

Railway Law—2 hours. Rules of transport. Conclusion.

Tariffs—2 hours. Goods, tariffs, classification of goods, calculation of the tax for official despatches, normal weights, proof way. Internal and external bills of lading. The principal foreign tariffs system.

Practical Exercises—4 hours. A continuation of previous work, goods tariffs, accountancy in respect of goods received, luggage, and goods despatched for a definite period. Monthly calculations in reference to the same.

The above course sufficiently indicates the thoroughness of the Swiss scheme of education for the railway service.

17. *Course for Surveyors and Agricultural Technologists.*—The following are the details of the work in the *Schule für Geometer und Kulturtechniker*:—

Class I (Summer)—

German—3 hours per week.

Arithmetic—4 hours.

Algebra—4 hours. Repetition of elements, theory of indices, subtraction of square and cube roots with numbers and polynomials. Systems of linear equations.

Geometry—4 hours. Recapitulation and extension of planimetry, stereometry, intersection of planes and lines, angles and distances, solid angles.

Physics—4 hours. Experimental introduction, physical units, mechanics of solid fluid and gaseous bodies.

Chemistry—4 hours. Metalloids, their most important combinations.

Linear Drawing—4 hours; *Freehand Drawing*—6 hours. Geometrical construction, surface decorations, plan elevations of geometrical bodies, simple ornamental "*motifs*," etc.

Geography—2 hours. Fundamental elements of mathematical and physical geography, orography, hydrography, climatology, and ethnography of Europe.

Caligraphy—1 hour; and *French*—3 hours. The latter deals with grammar from the stage treated in the Zürich Secondary Schools.

Class II

Class II (Winter)—

German—3 hours. Special regard to business style.

Algebra—4 hours. Powers and roots, complex quantities, system of second degree equations, logarithms and logarithmic tables, exponential equations.

Geometry—4 hours. Stereometry, simple solids and calculations, plane trigonometry, solution of right and oblique angled triangles.

Mathematical exercises—2 hours. The whole range of planimetry and stereometry.

Descriptive Geometry—4 hours. Representation of points, lines, surfaces, determination of true magnitude, simple bodies, plane sections, interpenetration.

Physics—3 hours. Heat, meteorology, magnetism, static and dynamic electricity experimentally treated on a mathematical basis.

Chemistry—3 hours. Most important metals and their combinations; sketch of organic chemistry.

Plan drawing—6 hours. Alphabets, copying simple plans.

Geography—2 hours. America, Asia, Africa, and America, treated as Europe in the previous class.

Caligraphy—1 hour.

French—3 hours (Syntax).

Class III (Summer)—

German—3 hours. General and technical.

Algebra—4 hours. The progressions, interest and discount, amortizations, combinations, binomial theorem, integral positive exponents.

Geometry—3 hours. Continuation of trigonometry, analytical geometry of the plane, etc.

Mathematical exercises—2 hours. In trigonometry and the use of seven-place logarithms, theory and practice with slide rules.

Applied Descriptive Geometry—4 hours. Surfaces, theory of shadows, perspective.

Physics—3 hours. Optics and optical instruments used in surveying.

Mineralogy and Petrology—2 hours. Descriptions, etc., of the most important minerals, with special regard to building stone.

Surveying—5 hours. Units of length, etc., linear measurement, instruments for setting out right-angles, survey by means of these; level tube, and vernier, levelling instrument, profiles and cross-sections, contouring.

Field-practice—4 hours. Exercises corresponding with theoretical course.

Plan-drawing—4 hours. Cadastral plans, survey field notes.

Agricultural Botany—2 hours. The organs and structure of plants, important plants in agriculture and forestry, their relation to the soil, Sketch of systematic botany, botanical excursions.

Class IV (Winter)—

Algebra—3 hours. Binomial theorem, fractional and negative exponents, computation of probability, infinite series, criteria of convergency, interpolation.

Analytical Geometry—3 hours. Conic sections, equations, tangent problems, construction, discussion of general second degree equations.

Mathematical exercises—4 hours. Planimetry, stereometry, and plane trigonometry, calculation with special regard to survey practice.

Spherical Trigonometry—2 hours. Spherical trigonometry, formulæ for plane triangles from spherical, errors in the axes of theodolites, problems in mathematical geometry, simple map projection.

Mechanics of construction—4 hours. Composition and decomposition of forces, force polygon, lever, pulley, inclined plane, centre of gravity, Guldinus' theory with applications, simple beam, theory of elasticity and applications.

Materials of construction—2 hours. Natural and artificial building stone, wood, metal, cements, asphalts, etc.

Theory of Building construction—4 hours. Bonding arches, vaults, small bridges, and stone and wood.

Surveying—6 hours. The Swiss level surveys of precision, practical dioptrics, plane table and its use, topographical surveys, theodolite and its use, calculations of polygons, Pothenot and Hansen's problems.

Plan and Map-drawing—6 hours.

Class V (Summer).

Computations—2 hours. Calculations of polygons, etc., areas, subdivion of areas, closing, etc.

Surveying—4 hours. Areas by different methods, planimeters, subdivision, closing, etc., trigonometrical and barometrical hypsometry, setting out of curves, etc.

Survey practice—10 hours. Surveys covering the range of work theoretically discussed.

Plan and Map-drawing—4 hours. Construction of accurate plans of surveys made.

Agricultural Chemistry—3 hours. Air, water, the soil, plants, their building up from organic materials, nourishment of plants, natural and artificial manuring, manufacture of fertilisers, agricultural products.

Higher Analysis—4 hours. Differential and integral calculus, particularly as it relates to geodesy, differentiation of simple functions, maxima and minima of functions of one or more variables, with or without approximative conditions, Taylor's theorem, solution of transcendental and higher degree equations by approximations, the simple integral, quadrature of plane surfaces.

Determination of geographical position—1 hour. Spherical co-ordinates, etc.

Geology—2 hours. Action of water, ground-waters, springs, flowing water, talus slopes, alluvial land, formation of mountains, the Alps and Jura, history of the earth's crust, glaciers and moraines, formation of the soil, kinds of soil, excursions.

Theory of Building Construction—4 hours. Iron constructions, exercises.

Class VI.

Class VI (Winter)—

Theory of errors of observation, correction by means of the method of least squares—3 hours, theoretical; 4 hours, practical. Applications to problems in surveying and theory of instruments, average and mean error, the law of development of error, application to the criticism of errors in linear and angular instruments, levelling, etc., determination of trigonometrical positions, treatment of triangulation by Gauss' method.

Surveying—3 hours. Introduction to the important parts of higher geodesy, land surveying. Cadastral surveying, historical development of surveying, laws and regulations, the "*Cadastre*" (Kataster.)

Road Construction—lecture, 2 hours; practice, 4 hours. Profile and cross-sections from level surveys, calculations of quantities from vertical and horizontal profiles, disposition of materials, transport tables, width, fall, etc., of railroads and streets, protection, retaining walls, culverts, and small bridges. Practice (4 hours), design of a street, computation of quantities, small artistic structure, and estimate of costs.

Theoretical Hydraulics—2 hours. Rainfall, properties of water, soil and water, natural streams, fundamental theory of hydrostatics, efflux through orifices, overfalls, hydraulic measurements, velocity and slope, motion of water in open channels and in pipes.

Practical Hydraulics—lecture, 2 hours. Draining and irrigation, regulation of streams, Swiss torrents. Exercises—2 hours. Drainage project, simple brook.

Amelioration, Drainage, etc., of a Field—4 hours. Development of the scheme for a field of about 15 hectares.

Water Conservation, Canalisation, etc.—Exercises, 4 hours.

18. *Concluding Observations.*—The preceding incomplete account of the lower and middle grades of technical and industrial education in Switzerland, at least gives some idea of the range of effort to make the Swiss industrially efficient. There are many other schools to which reference might have been made. For example, such schools as the Municipal "*Ecole d'horlogere*," of Geneva, which is maintained by the city, with the aid of federal subsidy, school fees, and private donations. Such a school, while the chief feature of its work is watchmaking, etc., educates a class of workmen and workwomen competent to undertake all sorts of fine mechanical work; such, for example, as the beautiful graduating machine of the "Bureau International des Poids et Mesures," of Paris, electrical and physical apparatus, etc., as well as watch and clock making, electrical clocks, etc.

There is, however, no necessity to attempt a complete account of technical education in each country, and what has been outlined is sufficient to disclose the national value of the forms of Swiss education for practical life. Swiss Agricultural and Commercial education are dealt with later in this Report.

CHAPTER XII.

Continuation, Trade, and Lower Technical Education in Austria, Bohemia, and Hungary.

[G. H. KNIBBS.]

1. *Introduction.*—The great strides in technical education which have been made in Europe generally, are reflected in the recent educational history of Austro-Hungary. According to statistical information kindly supplied by His Excellency, His Brittannic Majesty's Ambassador in Vienna[1], there are no less than 1,028 technical schools, with 7,080 teachers, and 108,585 pupils, made up as follows [2]:—

Kind of Institution.	Schools.	Teachers.	Students.
	No.	No.	No.
State Industrial Schools and allied Institutions	21	595	4,152
Schools for single industries or trades	163	999	9,433
General schools for workmen	11	116	1,296
Industrial continuation schools	833	5,370	93,704
Total	1,028	7,080	108,585

The instruction covers such courses and subjects and meets the requirements of such classes of tradesmen and workers as are indicated in the following list, viz.:—Stonemasons, bricklayers, carpenters, joiners, cabinet-makers, furniture makers, artistic joiners, wood carvers, sculptors, modellers, drawing for the artistic industries, tinsmiths, locksmiths, decorative painters, modellers in ceramics, ceramic painters, glassworkers, turners, enamellers, embossers, chasers, engravers, jewellers, gold and silver smiths, metal workers, boilermakers, mechanics, locomotive drivers, fine mechanicians, electro-technical workers, spinners, weavers, embroiderers, workers in chemical industries, dyers, textile industries generally, flower painters, basket makers, courses for repairs of carpets, tapestries, etc., and many others.

The significance of the statistical results furnished, will not be adequately appreciated unless the rapidity with which the provision made for technical education in Austria, is recognised.

Austria.

2. *Rapidity of development of technical education in Austria.*—The Ministry of Public Instruction in Austria, in its present form, was created in 1848, at which time there existed only the following establishments, viz.:—The Polytechnic of Vienna; similar institutions at Prague and Graz; the commercial academy of Lemberg; "professional schools" at Vienna, Graz, Brünn, Prague, Trieste, Brody, Rakonitz, Reichenberg—eight in all; drawing schools at Prague, Olmütz, Lemberg, and Graz; a school of applied drawing at Vienna. Nearly ten years earlier the idea of schools more closely meeting the practical needs of the people had asserted itself, and the early ideas as to the best constitution for "*Realschulen*," accentuated the recognition of the need for industrial instruction. The Minister, Count Leo Thun, gave his attention to the question, and on 2nd March, 1851, the organisation of industrial and technical education commenced. The backward state of Austrian industry, as compared with that of other countries, concentrated attention to the question of the necessity for this.[3]

The early "*Realschulen*" of Austria gave elementary industrial instruction. There were two grades—the lower, with two years' study; the higher, with three years. There were also Sunday courses for workmen.

Tha Imperial decree of 8th August, 1868, reconstituted, however, the *Realschulen*. They became schools—the aim of which was to provide a *general education*, in which special importance was attached to mathematical science, the natural sciences, and modern languages. A second aim was that they should constitute a normal preparation for higher technical schools, polytechnics, the forestry academy, mining academy, etc.

This reform is recognised as a wise one, and it forced the Government to consider the question of providing adequate technical instruction. While the State was hesitating, the local authorities took the initiative, and established a considerable number of schools. Even as late as 1870 little had been done by the State. It will be seen from these facts that the great development of technical education in Austria has taken place within three decades.

3.

[1] To whom the Commissioners are under very great obligations, and to whom their best thanks are due for great courtesy, and for the information obtained by His Excellency's exertions.

[2] Statistik der Unterrichtsanstalten in den im Reichsrathe vertretenen Königreichen und Ländern. Wien, 1902.

[3] *Apropos* of this, the little brochure of Dr. Adolf Müller, Sectionsrath im k. k. Ministerium für Cultus und Unterricht, entitled "*Das gewerbliche Bildungswesen in Oesterreich*," is worth reading. Staatsdruckerei, Wien.

3. *Delays in developing Technical Education in Austria.*—It is worthy of mention that delay and difficulty arose through questions of administration. The Minister of Public Instruction and the Minister of Commerce were both interested in industrial and commercial schools, etc., and an attempt in 1872 by a ministerial committee to distribute the responsibility was a failure. The arrangement was as follows:—

Under the Minister of Commerce were placed—

(1) Schools of a definite technical character, which afforded instruction in a domestic or a manufacturing industry, but did not embrace, or which embraced in a very restricted way, subjects relating to general or industrial education.

(2) Weaving schools, and any others which did not constitute a branch of a general industrial school.

Under the Minister for Public Instruction were placed—

(1) Schools in which the plan of instruction tended to provide an education of a general character.

(2) Schools which were designed to make good the deficiencies of primary education—*e.g.*, schools of apprenticeship, or apprenticeship courses in schools forming annexes to primary schools.

(3) Schools which should be considered secondary industrial schools, in which there were several special divisions.

It is easy to see that authority so divided could hardly be satisfactory, especially when the intimacy of the relation of various forms of education is kept in view.

In 1875 an important step was taken, consequent upon a report of Von Dumreicher, viz., the creation of the "*Staatsgewerbeschule.*" These state industrial schools were divided into lower and higher schools, differing essentially from one another, in the following way:—

The lower class of school aimed at extending, as quickly as possible, the education of those who may desire to become superior workmen, overseers, etc., in the building industry, in metallurgical and chemical industries, and in particular callings of like character. The courses were so designed as to assist the students to become foremen, overseers, heads of industrial establishments, designers, etc., and at the same time it greatly improved the efficiency of the workmen. The complete course of instruction was generally of two years' duration, and demanded only a primary school preparation; and, if the locality allowed of it, some practical instruction in some industry or calling was also demanded, or at least encouraged.

The Higher Industrial School (*Höhere Gewerbeschule*) was organised in a very different manner, both as regards its aim, method, and initial requirements. The *Höhere Gewerbeschule* was the natural continuation school for the lower secondary school (*Untermittelschule*) and it consisted of a course of three classes, each of one year's duration. It endeavoured to provide that knowledge of science, of the technical arts, and that practical skill, which would qualify men to become master-builders, contractors, directors of mechanical and metallurgical workshops, and of small factories; to become the proprietors of industrial establishments of a mechanical character; to become mechanicians in railways and factories, foremen of works in breweries and distilleries, etc. It was therefore necessary to give considerable attention to those general elements of education which such industries and callings demanded, in order that their progress might be reasonably assured.

Industrial schools often had schools of apprenticeship as annexures.

In 1881, the creation of a "Higher Direction of Industrial Education" under the Ministry of Public Instruction, was the first step toward constituting practically a new era, leading to the more complete organisation of technical education.

In 1883, there was an important reform in the schools of industrial apprenticeship. Their organisation was improved by dividing them into general industrial schools for all industries (*Die allgemeine gewerbliche Schulen*) and special schools for certain industries or for groups of cognate industries (*Die fachliche Fortbildungsschulen*). Special technical schools are known as "*Fachschulen,*" and the general school of apprenticeship as "*Die allgemeine Handwerkerschule.*"

The special industrial schools (*Gewerblichen Fachschulen*), which formerly often had merely the character of model workshops, became, by reason of the reorganisation, in the truest sense schools of special technical education. The distinction between a school, properly so-called, and the workshop became increasingly clear, and the reform movement endeavoured in a thoroughly methodical manner to assimilate the intellectual elements of the calling in life with the practical ones.

A workmen's school, to be complete, must not only suitably continue the intellectual elements of education, it must also put them into practice as early as possible, and the reform referred to supplied and completed one of the ideas which were embodied in the Realschule that had been abandoned in 1867.

At the present time the organisation of the technical schools of Austria is very complete, and as each step has been taken with great deliberation, the delay has not been without benefit. And it may be observed that a thorough consideration of each step to be taken in education is the only way to make true progress.

4. *Courses in Austrian Technical Schools.*—It is not proposed to give details of the courses of the Austrian schools. They are very similar in character to those of Germany and other parts of Europe, and shew the same characteristic thoroughness of method and development. The same care is taken that the instructors shall be educationists as well as workmen. It will be sufficient therefore to give a general account of the provision made in typical schools for the technical education of the Austrian people, and will be regarded as unnecessary to go into the individual elements of the curricula. A few typical programmes will be given in section 13, hereinafter.

5. *State Industrial Schools of Vienna.*—There are two "*Staatsgewerbeschulen*" in Vienna—one established in 1870 and the other in 1899. The former has about 1,700 students, and the latter about 600. The former embraces—

(I) A higher industrial school with a general section of one year, the 2nd, 3rd, and 4th years being under two divisions, viz., (i) an industrial construction division, and (ii) a mechanico-technical division.

(II) A lower division, known as the school for overseers, etc. (*Werkmeisterschule*), with an industrial construction section.

(III)

(III) A series of special courses for master-workmen and their assistants. These courses include instruction for the following:—(a) Those having charge of boilers, machinery, and ships; locomotive drivers, mechanics, etc.; (b) engine-fitters, etc.; (c) bricklayers, stone-masons, carpenters; (d) for joiners and cabinet-makers; (e) furniture and artistic cabinet-makers; (f) sculptors and modellers; (g) there is further an industrial-art drawing section, and (h) a general division.

(III) are winter classes; (I) and (II), both summer and winter.

The *Staatsgewerbeschule*, founded in 1889, has no *Höhere Gewerbeschule*, but has (I) a *Werkmeisterschule* for metal industries and for electro-technics; and (II) a series of five special courses, viz., (a) locksmiths and other metal workers; (b) mechanics in charge of boilers, engines, etc.; (c) locomotive drivers; (d) mechanics; (e) cabinet-makers.

6. *State Industrial School, Salzburg.*—The *Staatsg werbeschule* of Salzburg was established in 1876. It has three sections, viz.:—

(I) School for overseers and foremen, including an industrial construction division, and an art-industrial division, the latter subdivided into (i) general classes, and (ii) trade-school for cabinet-makers, modellers, and carvers; (II) a school for drawing and modelling, and (III) a special course for manual work for women. The courses are held both in winter and in summer.

7. *State Industrial School, Graz.*—The "*Staatsgewerbeschule*" of Graz, founded in 1876, has the following divisions, viz.:—

I. School for overseers (*Werkmeisterschule*) with an industrial construction division, having special schools for building industries, in the narrow sense, for carpenters, stonemasons, joiners, and for ironworkers; and also an art-industrial division, with special schools, as follows, viz.:—

(a) School for decorative painters.
(b) School for ceramics, for modellers, for pottery painting, etc.
(c) School for wood-industries, turners, cabinet-makers, wood-carvers, etc.
(d) For metal industries, chasers, engravers, decorative iron-workers.

II. Special Course for art-embroidery.

The preceding are all both summer and winter subjects.

III. Drawing and modelling, in summer only.

There are nearly 40 teachers, and about 300 pupils.
In the preceding schools, the language is German.

8. *State Industrial School, Trieste.*—The industrial school of Trieste was founded in 1887. It has about 1,000 students, and 40 instructors; the language spoken being Italian. The courses are as follows:—

I. Higher Industrial Schools, organised like the Vienna School.
II. Overseers' School. viz., an Art-Industrial School, with special courses, for wood-industries, ornamental sculpture and decorative painting.
III. Course in ship-building.
IV. Course for art-embroidery, lace-making. etc.; and
V. Evening and Sunday schools, with the following sections, viz.:—

(a) Bricklayers and stonemasons; (b) decorative painters and lithographers; (c) sculptors and carvers; (d) engine-fitters; (e) machine-shop mechanics; (f) German; (g) industrial book-keeping; (h) furniture making; (i) workers in electro-technics.

The courses are held both in winter and summer, excepting in the case of the evening and Sunday-schools.

9. *State Industrial School of Innsbruck.*—This school, established in 1884, has now a teaching-staff of about 20, a pupilage of about 200, and the following courses, viz.:—

I. School for overseers, with (i) an industrial-construction division, and (ii) an art-industrial division, having special courses for workers in the wood-industries, for workers in metal, and for painting.
II. Course in drawing for women.
III. Drawing for men.
IV. Special course for fine mechanics.

The above courses are held both in summer and winter, the language spoken being German.

10. *State Industrial School of Prague.*—The state industrial school of Prague, established in 1882, is a Czech school, with over 40 teachers, and about 600 students. It has the following courses, held both in winter and summer:—

I. Higher industrial school, with an industrial-construction division, a mechanico-technical division, and a division for technical chemistry.
II. An overseers' school, with a general constructional division, and a mechanical division.

11. *Other Industrial Schools.*—In Pilsen there is a German and also a Czech "*Staatsgewerbeschule*," each about the same size; the former having a higher industrial school; the latter an electro-technical division. These schools were established in 1877 and 1885 respectively, and have about 30 instructors, and about 300 students each.

The *Staatsgewerbeschule* of Reichenberg, established in 1876. with about 40 teachers and about 600 students, has a higher industrial school and an overseers' school. There is a division for chemical technology in each.

At Brünn there are Bohemian (Czech) and German *Staatsgewerbeschulen*, each with about 30 teachers, and between 400 and 500 students.

At Bielitz *Staatsgewerbeschule*, established in 1884, having now nearly 40 teachers and between 400 and 500 pupils, there is a higher industrial school, an overseers' school with divisions for colour manufacture (chemical technology), and weaving. Among the special courses there is also one for weaving.

In the *Polish Industrial School at Lemberg*, established in 1891, with now nearly 40 teachers and about 400 students, there is an overseers' school and an art-industrial school. The overseers' school has two divisions, viz., one for industrial construction, the other for art-industries. It has also drawing for women and drawing and modelling for men.

The details of sections of the overseers' school are as follows, viz.:

There are schools for (*a*) bricklayers, etc., (*b*) carpenters, (*c*) stonemasons, (*d*) joiners and cabinet-makers, etc.

In the art-industrial division there are (*a*) painters (*b*) sculptors, (*c*) artistic furniture makers, (*d*) wood-carvers, (*e*) turners, (*f*) artistic locksmiths, (*g*) embroiders, (*h*) lacemakers. There is also drawing, etc., for men and women.

The *Polish Industrial-Art School at Cracow*, established in 1876, and the German industrial state school at Czernowitz, call for no special comment, excepting perhaps that there is a course for drawing-teachers for the industrial continuation schools given at the Cracow school.

12. *The Art-Industrial Schools of Austria.*—There are special art-industrial schools (*Kunstgewerbeschulen*) at Vienna and Prague, to which some slight reference may be made. The *Kunstgewerbeschule* of the Imperial Austrian Museum for Art and Industry was established in 1867. It has about 23 teachers and about 250 students. It has the following organisation:—(i) general division; (ii) special schools for architecture, painting, and sculpture; (iii) special workshops for chasing, embossing, etc., ceramic decoration and enamel painting, the drawing of lace-designs, wood-carving; (iv) chemical laboratory.

The Prague school, established in 1885, the language being both German and Czech, has nearly 30 teachers and 300 pupils. It has four divisions, viz.: (i) a general division; (ii) drawing and painting school for women; (iii) special schools for art-embroidery, decorative architecture, wood-carving, modelling, art-industrial work in metals, flower-painting, textile art-industry; (iv) art-industrial evening and Sunday courses.

The above account will give a fair conception of the endeavour of the Austrian Government to meet the needs of its subjects in the matter of technical education.

What was seen by the Commissioners, both in Bohemia and Austria, in the way of material equipment and general organisation of technical education, was excellent. The strenuous efforts being made throughout Europe to improve technical education, and by this means to improve industrial efficiency, are as conspicuous in Austria as elsewhere.

13. *Typical programmes of Austrian Schools.*—The following series of programmes may be regarded as typical of Austrian Technical Schools. They are given in a work on "The development of industrial education in Austria" (*Die Entwicklung des gewerblichen Unterrichtswesens in Oesterreich*), by Rudolf, Freiherr (Baron) von Klimburg, the Imperial Royal Ministerial Vice-Secretary.

It is not intended to give the entire series of illustrative programmes; but merely a sufficient number to give a general idea.

Programme of an Ordinary Artisan School.

Subjects (Obligatory).	Classes, and Hours per Week.		
	I.	II.	III.
Theology ...	1	1	...
Mother-tongue and Business Terminology	4	3	...
Geography	2	1	...
Elements of Natural Science and Mechanics ...	2	2	2
Materials and Technology	2	4	3
Commercial Arithmetic ...	3	2	2
Industrial Book-keeping and Industrial Law ...	...	2	2
Freehand Drawing	6	4	4
Geometry, Geometrical, and Projection Drawing	6	3	2
Technical Industrial Drawing ...	...	6	8
Modelling...	...	4	4
Instruction, in order to give practical skill	6	9	14
Caligraphy	2	...	...
Total...	34	41	41
A Second Language	4	4	4

Programme

Programme of an Ordinary Industrial Continuation School.

Subjects.	Classes and Hours per Week.			Subjects.	Classes and Hours per Week.		
	Preparatory.	I.	II.		Preparatory.	I.	II.
Reading and Elocution	2	...	...	Business Documents, Terminology, etc.	...	2	...
Writing	1	...	...	Industrial Arithmetic	...	2	2
Arithmetic	2	...	...	Special Industrial Drawing	...	...	4
Elementary Freehand Drawing	3	...	...	Industrial Book-keeping	...	...	2
Freehand Drawing	...	2	...				
Geometrical Drawing	...	2	...	Total	8	8	8

Programme of a Mechanico-Industrial Special School (Klagenfurt).

Subjects.	Classes and Hours per Week.			Subjects.	Classes and Hours per Week.		
	Preparatory.	I.	II.		Preparatory.	I.	II.
Arithmetic	2	2	2	Technology	...	2	...
Geometrical Drawing	2	...	...	Book-keeping	...	2	...
Mechanical Drawing	4	6	6	Physics	...	1	...
Freehand Drawing	4	2	...	Chemistry	...	1	...
Caligraphy	2	...	...	Theory of Mechanism	...	...	2
German	2	1	1	Mechanics	...	...	2
Geography	1	...	...	Theory of Electricity	...	...	1
Natural History	1	...	...	Practical Instruction	35	33	37
Geometry	...	2	2				
Theory of Projection	...	2	...	Total	53	54	53

Programmes of Various Courses for Foremen (Werkmeisterschule).

Subjects.	Half-year Courses.											
	Chemical Industries.				Building Industries.				Mechanical Industries.			
	I.	II.	III.	IY.	I.	II.	III.	IV.	I.	II.	III.	IV.
German	4	3	2	...	4	3	2	...	4	3	2	...
Geography	1	...	...	...	1	...	...	...	1	...	...	...
Arithmetic	6	...	...	...	6	...	...	...	6	...	...	...
Geometry	...	4	...	...	5	4	...	...	5	4	...	...
Theory of Projection	...	...	...	...	8	8	...	...	8	7	...	...
Freehand Drawing	8	4	...	...	8	8	8	...	8	6	...	...
Natural Science	...	...	...	...	4	...	...	...	4	4	...	...
Mechanical Technology	...	...	3	4	...	...	...	...	4	...	...	...
Business Documents and Terminology	1	...	...	...	...	1	...	...	...	1	...	...
Algebra	...	4	...	...	...	...	4	...	...	4	...	...
Descriptive Engineering	...	...	...	3	...	...	...	...	...	5	3	3
Mechanical Drawing	...	...	...	...	...	...	...	...	...	6	14	18
Commercial Correspondence and Industrial Book-keeping.	...	...	2	...	...	...	2	...	...	...	2	...
Mathematics	...	...	...	...	...	...	...	...	...	...	4	...
Mechanics	...	...	...	...	...	...	...	...	...	...	8	10
Special Mechanical Technology	...	...	...	...	...	...	...	...	...	...	4	6
Special Engineering	...	...	...	...	...	...	...	...	...	...	...	3
Surveying	...	...	...	...	...	...	2	...	...	...	...	2
Physics	4	4	4	1	...	...	...	...	...	...	...	...
General Chemistry	8	4	...	...	...	...	...	...	...	...	...	...
Laboratory Practice	5	13	21	24	...	...	...	...	...	...	...	...
Chemical Technology	...	5	6	6	...	...	...	...	...	...	...	...
Mineralogy	...	...	3	...	...	...	...	...	...	...	...	...
Architecture	...	...	...	...	4	13	15	4	...	...	...	...
Architectonic Form	...	...	...	...	...	2	6	...	...	...	...	...
Architectural Mechanics	...	...	...	...	...	...	...	4	...	...	...	...
Design Drawing	...	...	...	...	...	...	...	21	...	...	...	...
Applied Freehand Drawing	...	...	...	...	...	...	...	10	...	...	...	...
Totals	37	41	41	38	40	39	39	39	40	40	37	42

Hungary.

Hungary.

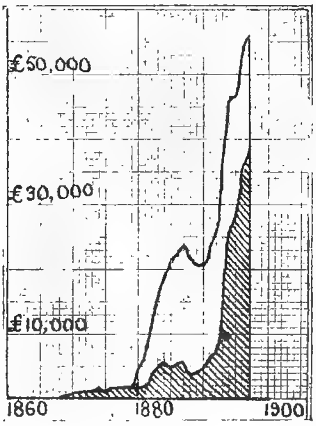
14. *Technical Education in Hungary.*—Both the lower and higher branches of technical education have been advanced greatly in recent years in Hungary.[1] It is proposed to first give a general outline of the provision made for the various branches of industrial education and then to afford sufficient indication of detail to disclose the grade of the instruction.

15. *The History of Industrial Education in Hungary.*—In the eighteenth century, industrial instruction, which, prior to that time, was fostered by the religious orders, became general in Hungary, and the whole educational scheme was organised under the initiative of the Empress Maria Theresa in 1770-1777. The first *development* of the industrial school, with an adjunct workshop for practice, was in 1779. In 1783 a decree of the Hungarian Government made it obligatory upon apprentices to attend the Sunday schools for drawing which the larger cities were required to establish, the provision being made more effective by a further decree in 1795. This latter prevented any master from receiving a boy as apprentice unless he had passed through the elementary school. He was required to attend the Sunday school for drawing for at least one year. Journeymen had also to attend, since without the attendance-certificate for the one year they could not become master-workmen.

Then a number of lower trade-schools were established in Budapest and some of the larger provincial cities, the apprentices being taught both on Sundays and in the evenings of week-days. This was about the middle of last century, when Budapest established the higher industrial school that has since developed into the polytechnicum.

By the law of 1872, apprentices were required to regularly attend apprentice-schools, the law of 1884 (No. XVII) making it obligatory on the communes to establish these wherever there were fifty apprentices working in shops or factories therein. (See Section 80.)

Industrial schools, covering a wider area of instruction, have in the last few decades been very rapidly developed. These embrace instruction for wood and metal workers, for weavers, for workers in the ceramic industries, etc. The diagram herewith will give a conception of the rapidity of the development between the years 1868 and 1897.[2] The shaded portion represents the contribution to the expenditure by the Department of Commerce, that unshaded the contribution through the education department, while the ordinates to the upper line represent the total expenditure.



16. *Organisation of Hungarian Industrial Education.*—Industrial education is well organised in Hungary—that is to say, while it is adjusted to local needs, it is uniformly developed and its parts are always organically coherent. The teaching is usually in Hungarian, but it may be in another language, provided at least two hours a week are devoted to Hungarian itself.

The *Department of Commerce*, which has a special bureau for industrial education, is *in charge of all technical schools*. On the other hand, the *Department of Education has charge of the schools for apprentices.* This organisation is not quite satisfactory.

The teachers of the latter schools are generally either—

(a) Teachers of elementary schools, or
(b) Teachers of secondary schools ;

and they teach in the apprentice-schools for a small additional salary.

The teachers of the technical and trade schools are generally of higher attainments. They are—

(i) Graduates in mechanical engineering in the polytechnicum (instructing metal and woodworkers, weavers, engineers, constructing machines, etc.).
(ii) Architects and sculptors (instructing stonemasons, etc.).
(iii) Chemists, modellers, sculptors, etc. (instructing workers in glass and the ceramic arts).

A provision worthy of note is that all the higher class of teachers are sent to notable schools in other countries, for at least a year, *at the expense of the State*, to study their special subject, or they enter the University and study appropriate special subjects.

The Department of Commerce sends also its trade-teachers to foreign countries to study the condition of trades and trade-teaching, and in general *each teacher has three or four years academic work supplemented by one year's travel in foreign lands.*

It will be recognised that the Hungarian *régime* tends to continually counteract insularity and self-sufficiency, and tends also to secure all those advantages which are derived by keeping in touch with progress elsewhere.

17. *Types of School for Technical Education, Hungary.*—The kinds of industrial schools, etc., provided, may be more completely classified as (a) general schools for industrial apprentices, and (b) professional schools for industrial apprentices. These two classes embrace such as the following, viz. :—

(i) Schools for apprentices.
(ii) Schools for advanced apprentices or journeymen.
(iii) Schools of design, and for industrial drawing generally.
(iv) Industrial schools for women.
(v) Trade schools, and schools for special subjects and crafts.
(vi) Lower industrial schools.
(vii) Higher industrial schools.
(viii) Technical industrial schools.
(ix) General culture schools teaching some branches of industry.
(x) Special educative museums illustrating various important industries.

[1] As the report of this Ministerial Councillor József Szterényi shews. Budapest, 1900.
[2] The laws of 1868 and 1884 concerning, respectively, primary education and industry, have exercised the chief influence on these schools.

Schools for Apprentices (i).—Trade apprentices are required to attend apprentice-schools. In some there are preparatory classes, in which the instruction is similar to that of the elementary school. Factory-proprietors and masters of shops, etc., are liable to fines of 50 florins (about £4 7s. 6d.) for failure to send apprentices to these special schools.

The schools for apprentices are maintained by a special tax, limited to 2 per cent. of the school-tax, and where this is not enough the deficiency is made good by subsidies granted by the Ministry of Education. Two hours are given twice a week and three hours on Sundays—that is, seven hours in all. As far back as 1895–6, Hungary had nearly 366 of these schools, attended by something like 72,676 pupils, and over 2,150 teachers. In 1896–7 there were 375, with about 77,000 pupils, and about 2,200 teachers.

Schools for Advanced Apprentices or Journeymen (ii) are maintained by contributions from the city authorities and the Government, supplemented by fees for tuition. They are relatively few in number.

The object of the *Schools of Design* (iii) is to improve industrial art and to introduce new applications of art into industrial pursuits.

Industrial Schools for Women (iv).—Schools with a two-years' course, the object of which is to qualify women for suitable occupations, exist in Hungary. Some are subsidised by the State, some by the Communal or Municipal authorities, and others are private. Drawing is a subject common to every one of these schools; and a foreign language, arithmetic, and book-keeping are included in the theoretical instruction.

Trade Schools and Special Schools (v).—There are also schools, under the Hungarian Department of Commerce, provided with workshops. These have courses of from one to three years.[1] Their aim is to qualify as skilled labourers for various trades, and also for industries that can be carried on at the home. There are also special schools.

The course of instruction varies very much in the trade-schools, but averages about ten hours a week theoretical instruction, and about forty hours a week practical work. A peculiar feature in Hungary is what may be called wage-work schools, in which the material is taken home and the completed work is brought back to the school.

Lower Industrial Schools (vi).—These are schools which merely prepare boys for entry into shops as apprentices.

Higher Industrial Schools (vii).—Excluding the polytechnicum, at the head of the industrial school-system, there are institutions which aim at thoroughly preparing such classes as foremen of factories and factories' proprietors. The courses are from one to three years, but latterly it has been felt that the highest courses should be extended to four years. Those who pass the highest courses have the term of military service reduced to one year. (It is thus similar to the *einjährige Examen* of the German system.) They have also preference in the lower offices of the customs, postal, telephone, and railroad departments. In some of the schools the teaching is of a fairly high grade, and the practical workshops, where nearly half of the time is spent, are on a large scale and are equipped with modern technical apparatus of an excellent character.

Among the noted schools may be mentioned that at Kaschau (Hungarian Kassa), a town of about 30,000 inhabitants, on the right bank of the Hernád, 173 miles north-easterly from Budapest. This school is devoted to the teaching of general mechanics, machine construction, electro-technics, and political economy.

The school at Budapest, one of the largest in Eastern Europe, teaches architecture, mechanical engineering, chemistry, metal work, and wood industries. In addition to the day courses, it had a number of special winter courses, as for example, courses for the building trades, and for stokers, engineering, for stationary and locomotive engines, etc.

At Kronstadt (Hungarian, Brasso, 115 miles northerly from Bucharest), is an industrial school for joiners, where the chief study is artistic wood-carving.

These industrial technical schools promote the excellence of Hungarian industry, and are considered one of the most promising types of practical schools, the instruction being very systematic, and combining both theoretical and practical features. The programmes hereinafter will give a general idea of the distribution of the work therein, and will be developed with sufficient fulness.

In order to acquire a more complete idea, we may adopt the classification of the Hungarian authorities. The Hungarian analysis is as follows:—

I. *Industrial instruction*:—
   (*a*) Schools for apprentices; (*b*) Improvement schools for young workmen.

II. *Professional instruction*:—
   (*a*) Schools for artisans; (*b*) Special schools; (*c*) Higher Schools of Arts and Crafts; (*d*) Schools of decorative art; (*e*) Industrial schools for young women; (*f*) Schools for industrial drawing; (*g*) Courses in the Museum of Industrial Technology.

18. *Hungarian Schools for Apprentices.*—These schools may be divided into two classes, viz., "general" and "special." The ordinary course lasts three years, the instruction continuing for ten months of each year; but in the case of the building industry it lasts only for six months. Four hours on two days a week are devoted to the acquisition of general knowledge, and three hours on Sunday to drawing.

There is a preparatory class for qualifying apprentices for entry who are not so qualified through their school career. The courses are calculated to give the apprentice an intelligent outlook upon the affairs of his country, the world, and his craft. The following sections give the details of the courses for the several years:—

19. *Reading on various subjects.*—Hungarian *Apprentice Schools.* The general reading is as follows:—

First Year.

(*a*) *Industrial Life.*—Extracts from the lives of celebrated manufacturers, exhibiting the qualities demanded in a manufacturer (love of work, exactitude, honesty, sobriety, the spirit of economy, purity of morals, respect for the law, patriotism, a conciliatory character; the duties of the apprentice toward his master or guardian; rules of good behaviour in the family, the school, and in public life.)

(*b*)

---

[1] The normal course in the professional school for apprentices is three years, the teaching extending over ten months without interruption.

(b) *Geography.*—Description of Hungary. Before and during the lessons the pupils learn to "read" the map, so as to discover the principal cities and highways of the country. The readings have an orographical and hydrographical orientation, and specially bear on the physical conditions of the country, and on the occupations of the people. As seven or eight hours per week only are set apart for these lessons, Budapest, the North-west Table-land, the South-west Table-land, the great plain, the Trans-Danubian region, the region between the Drave and the Save Save and Fiume, are treated in turn.

(c) *History of the Hungarian Nation.*—The historical facts which emphasise the patriotic virtues and the most brilliant epochs of the nation's past are related. The readings treat on the following subjects:—St. Stephen; introduction of the Christian religion, constitution of royalty, foundation of the first cities; Louis the Great; the Hungarian royalty at its apogee (the first corporation of trades; their flight from the towns). King Matthias Hunyady (Corvinus) and his Court. The Ottoman domination (decadence of the towns). Hungarian heroes in the Turkish wars). Maria-Theresa (colonisation, economic innovations, schools). Stephen Széchenyi (emancipation of the serfs, the suspension bridge, the first steamboats and the railways, the first manufactories, the Protectionist movement for industry). The laws of 1848 (equality of rights, abolition of the taxes imposed by the nobility, liberty of the Press, of public meeting, and in religion; electoral right, régime of national representation, etc.) The War of Independence, Francis Deák and the Compromise of 1867; present state of Hungary.

(d) *Public Hygiene.*—Influence of hygiene on the life of individuals and the nation. Wholesome and unwholesome food; alcoholism. Influence of habitation on the health (soil, aerification, lighting; manufactories and their sewage). The influence of a calling on the health (unhealthy manufactories and workshops). The care of the body (cleanliness, exercise). Infectious diseases. Prophylactics.

(e) Selections from Hungarian literature bearing on the historical and geographical subjects indicated above.

The readings during the second year embrace the following subjects:—

Second Year.

(a) *Geography.*—The countries of Europe and the other parts of the world. "Reading" the map of the world. The readings especially refer to the European countries which have an important bearing on Hungarian industry—that is to say, in the first place to Austria and the Balkan countries. In view of the limited time, the lessons bear upon the following subjects:—Our neighbours of the South (Roumania, Servia, Bulgaria, and the Ottoman Empire), Austria (Customs union; Austrian industry and Hungary; Hungarian exportations into Austria), the German Empire, France, Italy, England, The United States of America, The foreign countries (The Indies, China, Egypt, and Brazil).

(b) *Hungarian Legislation.*—The fundamental laws of the Hungarian Constitution: I. The Royal Power, the right of succession. II. Legislation; electoral right. III. Administration, Ministries, municipalities, communes. IV. Taxes, military service. The other lessons have reference to legislation concerning industry.

(c) *Physics.*—The qualities of bodies (solidity, hardness, elasticity, plasticity). Equilibrium. Centre of inertia. Lever, crane, winch, inclined plane, wedge, screw. Dynamics, uniform motion, fall, rotation. Communicating vessels. Hydraulic press. Archimedes' law. Flotation. Areometer. Hydraulic ram. Water-wheel, turbine, pressure of the air. The barometer. Pump. Fire-engine. The effect of heat. Conductors of heat. Thermometer. Water and heat. Steam. The steam-engine. Action of the sun on the earth. Atmospheric currents. Aerification. Heating.

(d) *Chemistry and Technology.*—Oxygen and nitrogen. Air, nitric acid, water, carbon (fuel, illuminating gas). Sulphur (sulphuric acid). Chlorine, bleaching. Silicic acid (quartz, sand). Boric acid, phosphorus. Lucifer-matches. Metals and salts; potash, soda, rock salt, lyes, salts of ammonia. Limestone and chalk. Cement and plaster. Aluminum, alum, clay and glass-making. The heavy metals: iron, copper, nickel, zinc, tin, lead, gold, silver. Metallurgy. Principal metallic salts, sulphate of iron, sulphate of zinc, etc.

(e) Such selections from literature as will assist in the development of the mind and character.

The reading during the third year treats of the following subjects, viz.:—

Third Year.

(a) *Physics.*—Sound, its origin and nature; hearing, musical instruments. Light and shadow; comparison between the light of a candle and oil-lamps. Mirror, lamp, rainbow. Phænomena of electricity; tension and energy of electric current; conducting wires; galvanic cells, batteries; electro-magnetism, and the rules of Ampère, electro-plating, electric lighting; electric bells. Morse's apparatus. Induction of current; electric dynamo-motors. The telephone.

(b) *Chemistry and Technology.*—Sugar, starch, gum, dextrine, cellulose. Flax, hemp, jute, cotton, and the textile products. Paper-making. Alcohol and vinegar (beer, wine). Products of animals and their use (meat, fat, soaps, and candles). Skins (tannery), hair, albumen, bone, horn (gelatine and glue). Petroleum (benzene, fat oils). Wax and ozokerite. Resin and pitch (gum-lac, varnish). Colouring substances (vegetable, animal and chemical).

(c) *Political Economy.*—Importance of agriculture, of industry and commerce. Domestic industry; small and large industry. Division of labour. Social and industrial rôle of machinery. Means of transport. Entry dues. Taxes. Important institutions for industry; associations, banks, postal savings-bank. Banks of issue. Industrial liberty. Chambers of commerce and industry.

(d) Such selections from Hungarian literature as will tend to a satisfactory formation of the character and mind.

In explaining the lessons, maps, pictures, and collections are used; and the instruction in physics is illustrated by experiment.

Where it is possible to augment the number of hours, as it is in some schools, one hour per week is devoted to the instruction in physics in Classes II and III, thus permitting of a fuller and more satisfactory treatment of the other scientific subjects.

In the apprentice schools for specific subjects, the lessons and readings are as far as possible made to refer directly to the industry in question; and in the third, or even in the second class, the hours usually given to Chemistry and Technology could be devoted to the special technology of the subject in question—that is, for one year.

As the time at the disposal of the pupils is extremely limited, it is as fully utilised as possible.

20. *Commercial Knowledge.*—The Course in business knowledge is developed as hereunder, viz.:—

Commercial matters and transactions (1 hour per week).

Object.—The pupils learn the character of business correspondence and documents in so far as it is necessary for a trader or manufacturer.

1*st Class.*—In explaining the selections for reading, the pupils are taught the rules of grammar required for orthography and commercial style; the composition of phrases, suffixes of declension and conjugation, and are required to make compositions for the purpose of employing the rules of orthography.

2*nd Class.*—(a) Commercial documents (advertisements, vignettes, circulars, insertions in the day-book, placards), current-prices, offers of buying and selling, commands, demand for payment, telegrams, requests for information concerning merchandise or persons, offers of service, letters of recommendation. (b) Business documents, receipts, invoices, quittances, note of deposit, letters of credit, certificates, custom-house declarations, power of attorney, cessions, contracts.

3*rd Class.*—After having recapitulated the subjects of the preceding class, the following documents are drawn up, viz., petitions, licenses, contracts with regard to the relations between masters and their journeymen and apprentices, passports, patents, commercial traveller's license, petitions in industrial matters.

The

The subjects of 2nd Class, enumerated under (*a*), recur the most frequently in the life of the artisan, and are therefore treated thoroughly. The opportunity is thus given, and is embraced by the pupils, of accustoming themselves to express their thoughts in writing, and of avoiding the most common orthographial errors.

Among the subjects enumerated under (*b*), preference is given to the documents drawn up by a trader himself. For documents usually drawn up with the co-operation of lawyers, it will suffice to shew the pupils a single specimen so that they might be cognisant of its form. Among contracts, those which relate to apprenticeship are dealt with. Pupils are instructed that it is preferable to entrust to lawyers (" avocats" or notaries) the drawing up of the more important contracts and documents.

Such documents as bills, postal orders, bills of exchange, are dealt with in the courses in arithmetic and accountancy.

Documents usually drawn up on printed forms, are shewn to the pupils, and are filled up by them, and the method of affixing the stamp is explained.

In speaking of petitions, legal dispositions are explained, by virtue of which men of affairs have the right to address themselves to the authorities; the rules in force for such petitions are also taught.

The instructor explains the nature of the commercial documents by shewing their application to the various callings of the pupils.

The instructor does not merely dictate the rules and explanations; his efforts are directed rather to the multiplication of examples and practical exercises.

He sees that the compositions are well drafted and suitably written. Examples are written up on the black-board, so that each pupil may copy them. The compositions are carefully revised, and the pupils correct them themselves by means of explanations given by the instructor.

21. *Accountancy, etc., Apprentice Schools, Hungary.*—The instruction in computation and in accountancy, book-keeping, etc., is developed as follows:—

Calculation and Accountancy. (2 hours per week in each class).

Object.—The pupils are to be made acquainted with commercial computation and correspondence necessary for the rational management or development of small businesses.

1*st Class.*—The first four rules with whole numbers and decimal fractions, with examples taken from artisan's work; the metric system; local coinage; elements of the calculation of simple fractions; calculation of the surface of figures with straight lines and circles; calculation of the surface and volume of geometrical figures (prism, cylinder, pyramid, cone, and sphere).

2*nd Class.*—Ratio and proportion; calculation of averages; proportional division; proportion; alligation. These are all treated, not merely as examples of arithmetical operations, but in order to disclose the practical application of elementary arithmetic; percentages; calculation of profits and losses; capital and interest; general ideas concerning accumulated interest, savings banks (especially the Postal Savings Bank), the public funds, insurance companies; calculation of the raw material and selling prices; determination of the cost-price according to the current price and the invoice; making out estimates.

In dealing with calculations of cost-price, the significance of the terms employed in current-prices are explained, and also the methods of packing merchandise and marking the prices, of calculating rebates, and the indication of the destination of the merchandise. Methods of calculating net cost are explained with examples, and of adding expenses. Usances in the sale of the principal raw materials (wood, metals, leather, etc.) are explained.

The instructor selects the examples, taking account alike of the various industrial branches represented in the school.

3*rd Class.*—Accountancy in small shops: day-book, cash-book, order-book, principal register and inventory, bills of exchange. When time permits, book-keeping with regard to salaries, materials, and calculation of costs, is demonstrated. Book-keeping, method of making out the balance-sheet and inventory, are illustrated by examples drawn from industrial life.

Pupils are required to draw up at least one complete specimen of documents most frequently recurring, such as bills, invoices, and bills of exchange. The regulations of the commercial code are explained to the pupils, and they are instructed as to the judiciary value of books, the necessity of keeping the documents of correspondence, and the obligation of making out an inventory.

Examples are cited for the method of calculating the selling-price of the manufactured products, while putting into line of account the cost of the raw material, wages, interest on the capital, general expenses, etc. By means of these, the pupils learn to recognise the importance of book-keeping, since the elements which determine the selling-cost must be derived from the books.

22. *Instruction in Drawing, Apprentice Schools.*—In the teaching of drawing, other principles prevail than those which govern the teaching of general theoretical subjects. Whilst in the latter the system of classes is adhered to, in the former, pupils are divided into two groups, viz., a group for beginners and one for advanced pupils.

The lessons occupy a minimum of three hours per week in each class, and their object is to enable each pupil to acquire a knowledge of drawing sufficient for his calling. Since progress in drawing does not depend on the knowledge acquired in the other subjects, and that once the inclination and the understanding are awakened, the teaching must conform to the special needs of the callings selected by the pupil, pupils follow a general course and a course in special industrial drawing.

The general course includes all the pupils without distinction of class and calling; they are drafted into one class only, or into several parallel classes, and then divided according to their progress into beginners and advanced pupils. Drawing is taught for two or more semesters—in fact, until the pupils have acquired the desired taste and understanding. They are then eligible for entrance into the course in industrial drawing.

This latter course, therefore, is for all pupils who have acquired the desired propensity and judgment, and they are then classified by virtue of their callings into the groups shewn below.

The number of pupils and the local conditions determine the grouping adopted for this course. If the pupils are very numerous, and if also certain industries are strongly represented, the division and categories are multiplied, and the teaching is more specialised. The method resolved upon, however, is determined by the special conditions of each school.

The

The details are as follows :—

(A)—Course in General Drawing.

Object.—The pupil aims at attaining that proficiency in general drawing, so that he may be taught the technical drawing pertaining to his calling.

(*a*) *Geometrical Drawing.*—Employment of the principal drawing tools ; straight lines and circles (linear industrial ornaments) ; conception of solids, surfaces, lines, and points ; measurement of straight lines ; parallel lines : use of pantograph ; the circle and its constitutive parts ; measurement and drawing of angles ; construction of right-angles and perpendicular lines ; construction and properties of the triangle, the quadrilateral, and polygon ; reproduction, reduction, and enlarging of figures ; tangents of circles ; construction of elliptical lines, volutes, and spirals ; projection of geometrical figures, in plane, surface, profile, and in section ; exercises in the reproduction of simple figures, with the help of the rule and scale.

The subjects in drawing which are necessary for a calling are taught empirically without scientific explanations.

The constructions are made on the blackboard and the pupils copy them into their exercises ; then they trace them with pen and ink on the paper stretched on the drawing-board.

The pupils also draw geometrical ornaments from models sketched on the blackboard, or from drawing models, and practice compass drawing, and execute ornaments in two colours.

Inasmuch as geometrical drawing includes complementary explanations, construction of curves, importance is attached to accurate conceptions concerning projections and shadows, etc., in view of the requirements of their trade.

(*b*) *Free-hand Drawing.*—The straight line, traced in every direction, and subdivided by estimation ; drawing and divison of angles ; construction of triangles, quadrilaterals, and polygons, and their division. Plane geometrical ornaments. Curved lines ; arc, wavy line, circle, spiral ; combination of straight lines and curves ; leaves and flowers, ribbons, rose-forms, calyx. Geometrical solids ; blocks, edges, pyramids, cylinders, drawn in perspective. Conceptions concerning the shadow. Simple vessels, ornaments of leaves and flowers.

The drawings are executed on a large scale, utilising for them as much as possible the blackboard, the pupils accustoming themselves to draw true circles, at first with the pencil and then with the pen. While drawing the ornaments, their style and their application in the industrial arts are explained. The models are selected with discernment ; those are avoided which display neither taste nor skill.

23. *Courses in Industrial Drawing, Hungarian Apprentice Schools.*—The following are the several courses in industrial drawing :—

(B) Course in Industrial Drawing.

(*a*) *The Building Industry* :—

Masons.—Brick walls ; bricks in various positions ; joint, section, rectangular and oblique joints, crossing pillars, columns, rabbets, chimneys, and their angles. Rough dressed and dressed stones, retaining-walls. Systems of foundations. Vaults in brick and in stone. Conical and spherical vaults. Scaffoldings for buildings and frames for arches. Stone steps, footways, gutters, sewers. Joints and simple structures. Colonnades, mouldings, door and window frames.

House Carpenters.—Plans of simple habitations and agricultural constructions.

Carpenters.—Scarfing joints. Partitions, etc., framed structures. Determination of the form of roofs, purlins, rafters, etc. Roofs (thatch, rush, planks, shingles, tiles, and slates). Ceilings and floors. Staircases, in wood, cement ; doors and windows.

The drawings in plan, front view, profile and section are graduated as follows :—

(a) Drawing from a model to a definite scale ;
(b) Drawing from a sketch to a prescribed scale ;
(c) Drawing without sketch, from literal directions.

The drawings may, of course, be similarly adapted to any other industry.

(*b*) *Carpenters and Turners.*—Graduated drawing of furniture and household articles, so that the pupil can clearly indicate the various aspects of objects, viz., their front view, profile and section, as well as the dimensions. The sketches are made from models or from objects. Exact drawing of various projections. Execution of sketches on a large scale and their modification according to the instructions given.

After practising the drawing of figures, the pupil makes sections of the principal constitutive parts.

Finally, he prepares the plans of parts of household furniture according to the given conditions.

Freehand Drawing—

The pupils makes graduated drawings of ornaments, flat or in relief ; especially columns, mouldings, socles, and other important details in joinery. Ornaments are always related to furniture, and the pupil learns to judge the various styles. He studies and copies the designs of ancient and modern furniture in various styles, and also the figures of animals.

The work of wheelwrights and coopers is somewhat similar to that of joiners, but they need more practice in geometrical drawing.

Wheelwrights draw waggons, wheels, axles, axle-trees, carriages, boxes, side-ladders, and also the most common joints.

The drawings are graduated so as to enable the pupil to produce the sketches on a larger scale ; these he adjusts or modifies according to given instructions, making the form and structure of the waggons manifest.

Later he studies and copies designs of various styles of calashes, defining their style, solidity, and merit from an æsthetic standpoint.

The coopers design the form and repairing of tubs, casks, measures, vessels, baths, etc.

(*c*) *Ordinary and Artistic Locksmiths.*—The pupil reproduces in these sketches and drawings the common objects of his calling (railings, doors, consoles, iron utensils, economic furnaces), so as to become acquainted with the forms and the arrangement of the principal products of his art. He draws the objects on a large scale. He constructs objects of definite forms and dimensions, so as to become familiarised with the employment of iron rods. Drawings to a natural scale of joints, etc., with application of ornamental features drawn freehand. Drawing of special fastenings, afterwards to be constructed.

Freehand Drawing—

Volutes, curves, linear leaves and plants, rosaces, the figures of human beings and animals, occurring most frequently in the work appertaining to locksmiths. The pupil in this way learns how to analyse and estimate the style and structure of the models that he has to copy.

Finally, he studies and copies the designs of antique and modern objects of selected style.

(*d*) *Tinsmiths and Braziers.*—Sketches of the principal products of these callings, study of their form, colour, and proportion. Constructions of drawings to a definite scale ; reproduction of surfaces. The measurements of one and the same form drawn to various scales. Construction of slabs and plates required for the formation of funnels, baths, mouldings, sky-lights, etc. Execution of sketches in large dimensions ; drawing of details.

Freehand drawing bears on the columns, mouldings, linear leaves, the figures of human beings and animals, and on the selected objects or designs.

(*e*) *Mechanicians.*—The commonest parts of machines, such as belts, screws, nuts, chains, hooks, joints, cocks, valves, axles, keys, winches, spur wheels, pulleys, drums, pistons, etc. Drawings of machines and simple tools.

The work is graduated ; primarily, the sketches are traced on a large scale ; then a drawing is made from the dimensions on the sketches, and finally the object itself is constructed. The *founders* design castings and the smiths the forge-work ; the latter design also the iron-work of vehicles, ordinary tools, such as hammers, axes, and wedges ; copper founders reproduce the products of their special art.

(*f*)

(*f*) *Goldsmiths' Work, Bronzes, Engraving.*—Pupils draw and model as ornaments, in plan and in relief, figures of human beings and animals in outline, and also in a more realistic style. Large objects are modelled in clay and small ones in wax.

Theoretical explanations and the practical drawing of the various styles of architecture and classic pottery are united to these studies.

Pupils do not confine their attention solely to the study of antique and modern jewellery, etc., but Hungarian ornaments, tissues, embroideries and laces of indigenous production, and the forms and combinations of colours of the old enamelled jewellery of Hungary and Transylvania receive also considerable attention.

(*g*) *Upholsterers, Decorators, and House-painters.*—Ornaments in plan and relief; natural flowers. Studies of drapery for curtains, baldachins, decoration of furniture. Exercises in the combination of colours. Studies in the various styles of architecture, especially from the point of view of the decoration of apartments. Drawings o ancient and modern styles for textile fabrics and embroideries; coloured papers, leather hangings, laces and curtains; analysis, drawing and study from the point of view of the harmony of colours. Sketches of decoration drawn on a very large scale. Plans of decoration.

24. *General Remarks on the Drawing Courses.*—These programmes of studies have indicated the subjects of instruction in drawing given to the various groups of pupils, but it can rarely be exhaustively dealt with. The principle, therefore, that the artisan should primarily know the main features of construction, etc., is strictly adhered to. The most simple objects are taken for the point of departure, viz., that which most commonly occurs in each particular trade.

The instruction is both individual and collective, so that the special aptitudes of each pupil may be under observation. Drawing models are employed, but the placing of the model itself on the drawing board is prohibited. Care that they make a proper use of the rule is also taken.

Whenever possible, pupils are permitted to inspect not only the drawing model, but also the object it represents, so as to receive the full benefit of the lessons. From time to time objects taken from life are drawn.

All drawings are to be executed in conformity with the requirements of the industrial branch in question, avoiding superfluous work. In the building-industry section the materials employed are treated exactly as in the architects'. Mechanicians enter the dimension-lines in red ink.

Pupils who use drawing and painting in their calling, as for example, painters on glass windows and porcelain, lithographers, engravers, and others, are taught to discern not only the outlines but also the tints of light and shade. For the callings where drawing is used only for rough draughts for the confection of articles, the shade is distinguished by, at the most, several strokes of the pen, simply because it makes the drawing clearer.

The "*motif*" is drawn once only.

The artisans, not mentioned in the above groups, draw from models relating to their callings. Thus watchmakers draw works and cases. Sign-writers, painters, and book-binders draw ornaments applicable to their callings.

A review of the preceding programmes will disclose the fact that the industrial workers of Hungary are not only taught, by means of the general part of the educational programme, to intelligently appreciate their relationship with the world in general, but also, by means of the more special part and by the scientific teaching, to understand their callings, and the foundations on which they rest.

25. *The Commercial Apprentice Schools.*—Parallel with the industrial apprentice schools are the *commercial schools of apprentice*, whose organisation is, in the main, on a par therewith, since the Hungarian legislation does not make a distinction between industrial and commercial education of apprentices.

The Communes, for the most part, maintain the industrial and commercial schools of apprenticeship, but the various commercial corporations also largely assist. Half of the 79 commercial schools of apprenticeship are not in reality communal, but are corporate institutions.

In these 79 schools there are 368 instructors whose qualifications to teach are as a rule higher than those in the industrial schools of apprenticeship. This curious fact is easily explained. More than half of the schools happen to be in towns where there are higher schools of commerce, and the natural consequence is that the commercial schools of apprenticeship do their best to secure teachers from the higher commercial schools.

From 1897–98 the 79 commercial schools of apprenticeship were attended by 6,205 pupils, of whom 936, 15·2 per cent., attended the preparatory class, 2,618, or 42·1 per cent., the first class, 1,795, or 28·9 per cent., the second class, and 856, or 13·8 per cent., the third class.

Commercial schools will, however, be dealt with in a later chapter of the Report.

26. *Special Technical or Industrial Schools, Hungary.*—The educational authorities of Hungary attach great importance to the middle degree of "professional" education; that is, education in one of the "special schools." Excepting in the case of the textile industry, the minimum age of admission is 12, and the pupil must have successfully passed the examination of the 6th class of the primary, or the 2nd class of the secondary school.

The courses may be divided into I. General instruction; II. Drawing, etc.; III. Special subjects. Whatever the school, I is alike in all.

The general instruction embraces:—

(1) *Hungarian*, and its form in business and industry.

(2) *Arithmetic and Geometry*, with their applications.

(3) *Physics and Chemistry*, treated in a very general way, but experimentally illustrated.

(4) *Writing.*

(5) *Industrial accountancy*, dealing with the principles of cost, sale, profit and loss systems of book-keeping as applied to industries.

The

The division of time in the general instruction is as follows:—

General Instruction in Special Industrial Schools.

Subject.	Courses, and Hours per Week.			
	I.	II.	III.	IV.
Hungarian	2	2	2	1
Arithmetic and Geometry	4	2	1	...
Physics and Chemistry	2	...	...	...
Caligraphy	1	...	...	...
Book-keeping, etc.	...	...	2	...
Totals	9	4	5	1

Excepting in the schools for textile industries, *drawing* involves six hours a week, viz., four hours for ornament drawing, two hours freehand drawing of natural objects, plaster casts, etc.

In the following sections are given the general idea of each school:—

Modelling in the first course occupies three hours a week in all cases except in the school for textile industries and in that for wood-carvers, the latter giving six hours a week to the subject. The time-table is as follows:—

Time-table for Modelling.

Section or School.	Courses, and Hours per Week.			
	I.	II.	III.	IV.
Wood and metal industries	3	2	...	...
Wood-carvers	3	6	6	9
Stone industries	3	4	4	4
Potteries, etc.	3	4	4	4

The time-table for *geometrical drawing and descriptive geometry* is taken for all sections except that for textile industries six hours a week in the 1st course, and in the 2nd course two hours a week.

27. *Special Schools for Wood-industries.*—The time-table of this school is as hereunder, the general subjects being those previously defined.

Programme of Hungarian Schools for Joiners, Cabinet-makers, Turners, Wood-engravers, etc.

Subject.	Courses, and Hours per Week.			
	I.	II.	III.	IV.
General subjects	9	4	5	1
Drawing	15	8	4	...
Technological subjects[1]	14	10	16	17

Beside the above, there is workshop practice.

The details dealt with are the following:—

Construction in Wood and Drawing.—The range of instruction covers everything that can be imagined of use to wood-turners, cabinet-makers, and wood-carvers, etc. It treats, for example, of style touching upon Doric, Tuscan and Neo-Doric, Ionic (Greek and Roman), and Corinthian forms of columns, upon the architectonic parts of furniture, upon the forms of beds, chairs, tables, cabinets, sideboards, the fittings of libraries, offices, the forms of card-tables, billiard-tables, etc.

Technology of Wood.—The details of the instruction embraces the undermentioned matters:—

Technology of auxiliary materials for direct piecing together. Manner of fastening, classification. Dimensions, etc., of nails, screws, etc. Bolts and nuts. The making of glue, testing glue: its use. Procedure in ordinary glueing, in veneering, preparation and use of mastic, and of liquid glues.

Wood as a vegetable product. The morphology of the tree: its root, trunk, leaves, buds. Reciprocal relations of the three constitutive parts of a tree. Classification of trees: structure of the tree, its cellules and filaments: its growth: rings, dimension and division of cellules.

Sketch of the tree. The chemical composition of wood. Technical qualities of wood. Defects in wood. Essential qualities for wood intended for building, use, etc. Processes for rendering wood more resistant, *e.g.*, treatment of tree before and after cutting, process of treating with lye, drying in air or in drying ovens.

Construction

[1] A change has been made since by way of increasing the time spent in the workshop.

Construction of drying ovens. Conditions and procedure in artificial drying. A simple drying oven for artisans: drying apparatus in which air, steam, smoke are used.
Impregnation of woods by chloride of zinc, and tar, by the aid of pneumatic apparatus. The Bocqueric and Pfister processes. Explanation of the advantage of impregnating wood.
Explanation and use of the various sorts of wood most used in industries and technology.
The wood worked up: tools, apparatus, and machines for woodwork (these are treated with considerable fulness).
The polishing, dyeing, etc., of woods. Action of bases and acids on the colour of woods. Colouring matters, and their resistance to the action of water, light, etc. Preparation and use of colouring matters with various kinds of wood. Varnishing woods, colouring matters for varnishes. Varnishes with and without oil: polishes. Waxes, and their use with furniture. Oily lacquers and alcohol. Materials for hardening woods.
The production of wood, centres of production and commercial routes. Cutting and sawing, forms and dimensions, classification of articles, common usages.
Joinery workshops, without machinery, with minor machinery, with complete mechanical equipment.[1]
The technology of turning, and of veneering, sketching and drawing of pieces of joinery, etc.

Descriptive Mechanics.—The object and grouping of machines, their parts, the use of levers, pulleys, spur-wheels, lifting-apparatus, ordinary and steam pumps, heaters, portable engines, expansion of steam, water-wheels, turbines, gas, benzene and petroleum engines, etc., are explained or treated under the above heading.

Construction and Constructive Drawing.—Five hours a week are devoted to this subject, two to explanatory work, and three hours to drawing.

It will be seen from the above outline, translated from an account thereof, that the tradesman who passes through a course with such features is likely to have an intelligent conception of his work.

28. *Special Schools for Iron Industries, Metal-workers, Mechanics, etc.*—There are two sections in these schools, one for mechanics, the other for ordinary and artistic locksmiths. The time-table is as follows:—

Programme of Schools for Iron Industries, Metal-workers, Mechanics, etc.

Subjects.	Courses, and Hours per Week.			
General studies	7	4	5	1
Technology	...	2	1	1
Study of industrial devices	...	...	...	2
Constructive drawing for metal-workers ...	5	4	...	5
Mechanical constructive drawing	...	5	7	7
Descriptive mechanics	...	2	2	3

The *practical work* is as follows:—Mechanics and locksmiths' mechanics spend three years in locksmithing and similar work, one semester is devoted to lathe-work, and one to forge work.

Metal-turners devote a year to locksmithing, etc., a semester to work in edged tools, and three semesters to lathe work.

Ordinary and artistic locksmiths devote two semesters to forge work, and four to the workshop and locksmithing.

Those who work in copper and bronze devote three semesters to locksmithing work, two semesters to metal-turning, and one semester to casting.

29. *Special Schools for Textile Industries.*—These schools are of two years' duration, but will probably be three years, if they are not so already. They give instruction in industrial drawing, in textile materials, in hand-weaving, weaving by means of machines, carpet weaving, analysis of woven materials. It is not proposed to give the details.

30. *Special Schools for Ceramics.*—The schools of pottery, etc., give instruction in general subjects, in general technology, caligraphy, industrial drawing, theory of construction, chemistry and mineralogy; in the special technology of pottery, and require the students to pass through chemical exercises in the laboratory. Details of the courses need not be given.

31. *Various other Schools.*—Budapest possesses a State School for fine mechanicians, and for watch and clock making, and there are are at Nagy-Szeben schools, subsidised by the State, for tannery and shoe-making. The higher school of arts and crafts is a very much more advanced type of school than those previously referred to, and will be dealt with in a later part of the report.

The school of decorative arts is practically of the same character as the higher school of arts and crafts, and will also be dealt with later.

32. *Special Courses in Hungarian Technical Schools.*—Besides these special schools, Hungary possesses what are known as special courses. These are designed to furnish professional education for adults, for master workmen, journeymen, and ordinary workmen. Some of these are evening courses, others day-courses, in the winter months. For example, the group of industries connected with building in a country like Hungary, are so hindered during winter that the time may be appropriated for special courses.

There

[1] It was stated on p. 21 of the preliminary Report of the Commissioners on Agricultural, Commercial, Industrial, and Technical Education generally, that in the final report of the Commissioners full accounts would be given of various courses, with the object of revealing the thoroughness of modern technical education in other parts of the world in all important branches. The above illustration will suffice.

There are a series of special courses, for example, for cabinet-makers, locksmiths, tinsmiths, wheelwrights, etc, in woodwork, polishing, gilding, wood-turning, the handling of machinery for woodwork, at the Technological Museum at Budapest. The following will give an idea of the frequency of such courses :—

Place.	Subjects.	Students.
Budapest... ...	Cabinet-making, locksmithing, tinsmiths' work, wheelwrights' work, wood turning, wood polishing, gilding, care of wood-working machinery, etc.	152
Kassa	Various courses in industrial drawing	44
Arad	Course in industrial drawing for cabinet-makers and artistic ironworkers	91
Kolozsvár ..	Ditto	188
Szeged	Ditto	25
Ujpest	Cabinet-makers	27
Nagyszeben ...	Shoemaking, etc.	11
Késmárk	Weaving, textile fabrics	17

Looking through the above, it will be obvious that a scheme of this kind tends to promote great industrial efficiency in any earnest community. It is to be remembered that such courses are often for adult workmen.

A consideration of some details is important; for that reason the special courses for persons engaged in building industries may be taken.

33. *Winter Courses for Building Industries.*—The following organisation is translated *in extenso* for the purpose of disclosing the detailed and methodical way in which Hungarian educational processes are worked out.

The organisation of the winter courses is governed by the following articles or regulations, viz.:—

ORGANISATION.

Art. 1.—The object of this course is to educate apprentices and working-masons, carpenters and stone-cutters, so that they may become overseers.

Art. 2.—The course continues for three winter semesters for overseers and for four winter semesters for master-masons, carpenters, and stone-cutters. The semester lasts from the 3rd November to the 31st March

Art. 3.—Apprentices or working-masons, carpenters and stone-cutters, who have passed the age of 15, and have exercised their calling for a year, are admitted as regular pupils, if they have attended the primary school or passed an equivalent examination.

If the room be sufficiently large, people, engaged in one of the abovementioned callings, who prefer a request to follow the course for the corresponding subject only, are admitted as occasional pupils.

Art. 4.—Applicants are required to present certificates of good conduct, of having completed his primary studies, and a vaccination certificate.

Art. 5.—For apprentices, admission should be applied for by their respective guardians or masters, who undertake that they will send them regularly to the school, and that they will not require any work of them during the school-hours.

Art. 6.—Pupils must present themselves personally for registration.

The registrations take place between the 20th October and the 2nd November each year. On the 3rd and 4th November the entrance and other examinations are held. Applicants, late in registering, but who have given justifiable reason therefor, may be allowed to the 10th November.

In cases of sickness, or from any other serious reason, admission may be applied for by writing, and by forwarding documents.

The pupils when admitted will receive a "certificate of inscription."

Art. 7.—The entrance fee is 2 crowns, (or a florin[1]) = 1s. 8d.; the school fee is fixed annually.

After the opening of the course there can be no restitution of fees paid.

Each pupil is requested to pay 4 crowns (3s. 4d.) for the use of the tools and equipment generally.

Art. 8.—Pupils who seek admission for the first year, and who do not possess the certificate of a primary school, are required to pass an examination on the subjects of the primary school.

These examinations are held before the Director (or his substitute) and the examining professor. The examination is gratuitous.

Art. 9.—The courses, including the drawing-lessons, take up forty-two hours per week.

The pupils must be punctual as to time, and remain during the lessons in the rooms assigned to them.

The pupils who intend to be absent from a lesson should previously obtain permission. Should sickness or other serious reason prevent them from attending, the parents, or guardians, or masters should immediately advise the Director, and when they return to school they are required to justify their absence.

If, for any reason whatsoever, the absence be of more than six weeks duration, the pupil will be considered to have abandoned the course and will be required to repeat it.

If the pupil be attacked with a contagious malady, the Director will allow him to return to school only if the Doctor of the school gives his sanction.

The Director is required to point out to the parents, or to the master or guardians, the failures, and to warn them of the consequences entailed by such failures.

Art. 10.—At the end of each semester the pupils undergo a public examination, and on this occasion their drawings are publicly exhibited.

The day of examination is fixed by the Director, with the unanimous accord of the teachers or professors. The Ministerial officer charged with the inspection of industrial instruction is also apprised thereof.

The pupils who can give sufficient reason may be exempted from this examination by the Director.

A pupil who misses this examination, without having had permission, will not receive a certificate and must submit to a complementary examination.

Art. 11. The pupils who have received the mark "insufficient" (elégtelen), for one or two subjects, but whose conduct has been satisfectory, will, upon application, be admitted to the complementary examination.

The pupil who fails at this examination, will be accounted as having discontinued the course; so also will the pupil who has received the mark "insufficient" for more than three subjects.

The fee for the complementary examination is 4 crowns (3s. 4d.) for each subject; half of this is devoted to the library, the other half is to remunerate the Director (or his substitute) and the examining professor.

Art. 12.

[1] The korona is half a forint or florin.

Art. 12. At the end of the year, each pupil receives a certificate, indicating his progress and conduct. The certificate is written on stamped paper and signed by the Director.

The pupil who has attended the complete course receives a certificate of studies, indicating the result of the three or four semesters, as the case may be.

This certificate of final studies is signed by the Ministerial Officer, the Inspector-General of Industrial Education, and by the Director and the Professors of the school.

The certificates require the following gradations :—

Progress : Excellent (jeles) ; good (jó) ; sufficient (clégséges) ; insufficient (elégtelen).

Compositions : Neat, tolerable, untidy.

Conduct : Perfectly satisfactory, decorous, unsatisfactory,

The pupil must pay a fee of 4 crowns (3s. 4d.) plus the stamp for this certificate. The original of the certificate of final studies is preserved in the archives.

Art. 13. The pupil who has attended three semesters only qualify as master-workmen. Those who have attended four semesters, and have exercised their calling for four years at least, may set up as overseers, etc. (the most highly qualified workmen).

Art. 14. Sundays, Catholic and national festivals are observed as holidays, also the day preceding and the day following both Christmas and Easter.

The Director may allow the absence of non-Catholic pupils for the festivals pertaining to their denominations.

During the vacations, which last from the end of March to November, pupils should exercise their calling and attest it by a certificate from their guardian or master.

This certificate should bear the signature of the proper president of the corporation of the particular calling or by the industrial or " administrative authority of first instance."

The pupils who have not employed their vacations at their calling, cannot pass into the higher class, unless they have obtained the permission of the School Council, or—in default of such a council—that of the Direction.

Art. 15. (*a*) The following pupils incur disciplinary measures :—

(1) Those who are negligent and who do not make good omissions of lessons.
(2) Those who have behaved disrespectfully toward any of the teachers or professors.
(3) Those who insult a comrade or do him an injury.
(4) Those who are addicted to gambling.
(5) Those who damage the building or the furniture of the school.
(6) Those who smoke in the school-building.
(7) Those who hold meetings in the school or elsewhere without the permission of the Director.
(8) Those who incite comrades to miss lessons.
(9) Those who participate in non-justifiable omissions.

(*b*) The disciplinary measures are the following :—

(1) Exhortation by the professor or teacher.
(2) Reprimand by the Director ; if the Director deems it necessary, he will inform the parents or guardians, advising them at the same time to remove the pupil from the school.
(3) Reprimand before the teaching staff. The pupil is warned of the withdrawal of his privileges. If he repeats the offence, dismissal from the school follows. The parents or corresponding guardians are informed by letter.
(4) Expulsion from the school.
(5) The pupil who absents himself entirely is absolutely dismissed.
(6) The pupil who has absented himself without excuse for more than twenty-four hours, will be deemed to have left the school.
(7) The pupil who absents himself for six hours without giving the reason thereof will have the mark, "not quite satisfactory"; and those who have made twelve absences in a semester will have the mark, " unsatisfactory."

The dismissal will be decided by the body of the professors, or teachers, or, on their proposition, by the School Council.

If the Director deems the presence of the pupil in fault is prejudicial to the other pupils, he may dismiss him without awaiting the definitive decision.

The programme of studies is so designed that the subjects taught in the three first semesters suffice for the master workmen, the fourth semester being necessary for master masons, carpenters and stone cutters.

Programme, Winter Courses, Building Industry School, Hungary.

Subjects.	Semesters, and Hours per Week.			
	I.	II.	III.	IV.
Hungarian language	5	4	2	...
Geography	3	...	...	...
Arithmetic, Algebra	5	4	2	...
Geometry and descriptive geometry	4	5	2	...
Geometrical drawing	8[1]	6[1]	4[1]	...
Freehand drawing, caligraphy	12[1]	8[1]	6[1]	...
Physics	...	4	2	...
Kinematics and descriptive mechanics (levers, pumps)	...	...	2	...
Surveying	...	...	2	2
Materials of construction	...	...	4	...
Constructive forms	...	...	2	10[2]
Carpentry	...	3	4	5
Constructive Drawing	5[1]	8[1]	10[1]	6[1]
Iron framework bridges, roads, hydraulic works	...	...	...	4
Plans of simple buildings	...	...	...	9[1]
Estimates	...	...	...	2
Book-keeping	...	...	...	2
Modelling	...	...	...	2
Totals	17 + 25[1]	20 + 22[1]	22 + 20[1]	22 + 20[1]

[1] These hours are occupied in drawing. [2] Six hours out of the ten are occupied in drawing.

34. *Details of Winter Courses for Building Industries, Hungary.*—The following translation gives a detailed idea of the way in which the courses shewn in the preceding table are taken. The very general character of these is worthy of attention.

DETAILS OF THE PROGRAMME.

1st Semester.

(1) *Hungarian Language.*—Phrases. The verb, conjugation, and formation of verbs; subjects and substantives and complements. The subject as adjective and adverb. Formation of subjects. Compound words. Rules of orthography. Readings in prose and verse. Compositions.

(2) *Geography.*—Description of Hungary and other countries of Europe. Frontiers, area, and constitution of Hungary; hydrography and orthography, towns and capitals of countries. Austria-Hungary, the "peninsula" of the Balkans, Italy, Switzerland, Germany, Holland, Belgium, the French Republic, England, Spain, the Scandinavian States, Russia, Asia, Africa, America, and Australia.

(3) *Arithmetic.*—Numbers and figures; the four operations, with fractions; units of measures. Addition, subtraction, multiplication and division.

(4) *Geometry and descriptive Geometry*—
   (a) *Geometry.*—Drawing implements. The point, straight line, and circle; measurement and division of distances. Origin and measurement of the angle. The triangle, the polygon and their construction. Equal figures; parallelism and symmetry of position. Similar and proportional figures. Tangent of the circle; inscribed and circumscribed figures; division, circumference and area of the circle.
   (b) *Descriptive Geometry.*—Body, plane, oblique plane, edges, vertices. Straight line and plane in space, inclination; angles. Geometrical solids; prisms, pyramids, cones, spheres.

(5) *Geometrical Drawing.*—Drawing of lines and angles; the square; parallel and perpendicular straight lines, drawn mechanically and graphically. Construction of triangles and polygons. The problems of the circle. Drawing of geometrical bodies.

(6) *Freehand Drawing.*—Ornaments derived from Greek architecture, copied from mural drawings. Drawing sketched with crayon, then with the pen, without shading.

(7) *Constructive Drawing.* -Simple constructions from sight.

2nd Semester.

(1) *Hungarian Language.*—Compound, subordinate, co-ordinate, and abridged phrases. The period. Prose readings relative to national history. Poetry. Themes: exercises in orthography and style.

(2) *Arithmetic.*—Relation of two quantities. Proportionality. Proportion. Interest. Rules of averages. Equations in general. Equations with one unknown.

(3) *Geometry and Descriptive Geometry.*—
   (a) *Geometry.*—Cones. Calculation of surfaces, Pythagoras' theorem. Properties of the polygon and circle.
   (b) *Descriptive Geometry.*—Projection, plane and projection ray. Drawing of straight lines, intersection of two planes; configuration of bodies under different aspects. Sections of bodies; mutual effects of bodies.

(4) *Geometrical Drawing.*—Various problems of descriptive geometry.

(5) *Freehand Drawing.*—Greek, Roman, Gothic ornaments and those belonging to the Renaissance, serving to illustrate special constructions, drawn from simple models or models in relief. Style of drawing; drawings with pen, shading, and colours.

(6) *Physics*—Its aim. The formation of bodies. Motion. Force; inertia, work, unit of work, the centre and line of gravitation, equilibrium. Mechanical elements; lever, inclined plane. Pulley, wheel, screw. Weight, density, elasticity, adhesion. The phænomena and laws of liquids. Tension, surface of liquid. Force and verification of the tension. Communicating vessels. Archimedes' principle. Flotation of solids. Capillarity. Phænomena and laws of gases. Weight and pressure of the air, barometer.

(7) *Construction.*—Constructions in masonry; the work of the mason and stone-cutter; brick walls and their joints; ashlar, mixed and stone walls; mud-walls, beton and mortar. Carpentry: simple scarfing, beams, and tie beams.

(8) *Constructive Drawing.*—Drawings of enumerated constructions.

3rd Semester.

(1) *Hungarian Language.*—Style and its elements. Principal kinds of prose. Ordinary correspondence, documents, business letters, certificates, petitions, obligations, receipts, invoices, acknowledgment of receipts, etc. Contracts for buildings, plans, description of constructions. Prose readings; exercises.

(2) *Arithmetic.*—Powers, squares, the cubes of algebraical quantities; roots, logarithms; series of logarithms, compound interest, amortisation, calculation of annuity.

(3) *Geometry and Descriptive Geometry*—
   (a) *Geometry.*—Numerous problems of calculation of areas, of volumes. Volume and surfaces of prisms, truncated pyramids, cylinders, cones, and spheres.
   (b) *Descriptive Geometry.*—Projection shadows: the shadow of bodies in plane and oblique surfaces; ray of light; perspective; configuration of the shadow and the perspective of simple objects.

(4) *Geometrical Drawing.*—Practical examples bearing on the ideas acquired in descriptive geometry.

(5) *Freehand Drawing.*—The parts and ornaments of the building, the mouldings, columns, capitals, pedestals, corbels, etc., drawn in large proportions (natural magnitude) from plane models or models in relief. Drawings in chalk, with pencil, and with pen, also in two light colours.

(6) *Physics.*—Dilatation of bodies by heat; thermometers, measures of temperature, specific heat; steam and its tension. Reflexion and refraction of light. Light, shadow, mirror; the law of refraction. Phænomena and law of magnetism and electricity; the compass, lightning conductor; poles, the effect of current. Production and propagation of sound, velocity of sound, reflexion, echo.

(7) *Surveying.*—Aim, processes and measurements; chart; real and optical horizontal line. Horizontal surveying; staves for fixing the points and lines; measurement of angles with the chain; set squares and graphometers; land-surveying for small pieces of ground. Levelling; making a vertical survey.

(8) *Materials of Construction.*—Classification of these materials. Ashlars, rocks, sands, volcanic rocks, artificial stones, mud-walling, bricks, mortar, chalk, plaster, impermeable substances, cements. Beton, mosaic, etc. Asphalts, limestone, etc.

Wood.—Its nature, solidity, resistance; cutting down and drying of the trees; rotten trees; coniferous and leafy trees; dimensions of the wood for commerce.

Metals.—Iron, steel, sheet-iron, iron-wire, sheet-zinc, lead, tin, copper; specific weights of the materials of construction.

(9) *Architectonic.*—Styles in general; the classic style; the styles of the Middle Ages; the Renaissance. Design and direction of the articulations. The systems of columns. Purpose and forms of the mouldings.

(10) *Constructions.*—*Stone constructions:* foundations; theory of vaults in brick and ashlars; various systems of vaults. Pillars, determination of their strength. Scaffolding for vaults. Flat beams; purpose and construction of iron joints. Mouldings and borders. Canals and sewers. Timber-work and joists. Roofs and girders.

(11) *Constructive Drawing.*—Drawing of numerous specimens of the above-enumerated objects.

4th

4th Semester.

(1) *Kinematics and Mechanics of Building.*—The effect of the movement and forces on bodies in motion and fixed bodies. Initial force and the determination of forces, explained by examples from practical life. Uniform and accelerated velocity. The centre of gravitation and equilibrium; the state of equilibrium of bodies in motion. Friction and the resistance of motion. Mechanical force; the meter-kilogramme; horse-power. Solidity of bodies: traction, folding and torsion; chains, cordages, cables, vertical bars; capacity of beams with one or two supports, with examples. Classification of machines. Employment of steam. Boilers in general and their various parts, pressure gauges, hygrometers. feed-cocks, etc. Different forms of boilers; masonry of the boiler. Furnace bars, flues, chimney. Levers, hand-winches, spur-wheels, simple cranes, cranes with pivots. Simple and double-action pump; centrifugal pump, pulsometer. Ventilators, bellows.
(2) *Surveying.*—Surveying of a more extended plot; set squares; graphometer; theodolite; drawing of elevated ground; levelling; drawing.
(3) *Architectonic Style.*—Various styles applied to the various parts of the building; colonnades, arcades, sanctuaries; façades, mouldings; drawing of various details.
(4) *Constructions*—The interior of the buildings; doors, windows, planks, roofs, thatched roofs, rush, shingle, tile, slate, sheet-iron, asphalt, wood, cement, pasteboard.
Carpentry: Girders, roofs of churches and halls, partitions, towers, staircases, wooden mouldings.
Iron-work, stoves, furnaces.
(5) *Constructive drawing.*—Drawing of the above-mentioned objects.
(6) Iron frames, bridges, etc., hydraulic constructions:
(*a*) Iron frames. Beams and columns in cast and rolled iron.
(*b*) *Causeways.* Breadth, section, elevation, sketches, levelling and construction of causeways.
(*c*) *Bridges*, simple, stone, wooden; heads of bridge, yokes, etc.
(*d*) *Hydraulic constructions*; foundations on firm ground, on piles, on sand, on beton, on grill-work, on piers, coffer dams, caissons, protection and revêtement of banks.
(7) *Plans of simple buildings.*—Plans of buildings of one story, of rural construction (warehouses, lofts, stables, sheds, etc.), with scale indication; section, profile, and façade.
(8) *Estimate.*—Plan and statement of the dimensions. Statement of the various industrial works, analysis of the costs, instructions, calculation of the estimate; sewer regulation.
(9) *Book-keeping.*—Object of book-keeping; weekly registers and their forms; statement of works performed and amounts to be received; day-book; cash-book; balance-sheet and account compared.
(10) *Modelling.*—Modelling of architectonic ornaments in clay; plaster mouldings.

Bearing in mind the qualifications of the instructors, it will be recognised that these courses are very valuable. There are actually five schools of this type, viz.:—

	Pupils.
Higher School of Building Industries, Budapest ...	122
Higher School of Arts and Crafts, Kassa ...	19
Special School for wood and metal work, Kolozsvár ...	25
" " " " Marosvásárhely ...	28
" " " " Szeged ...	41
Total ...	235

35. *Courses for Persons in charge of Boilers, stationary and portable Engines, Thrashing Machines, etc.*—There are three different courses under this head, and they are apparently worth translating to give a detailed idea of the thoroughness of the instruction.

Course I, for persons in charge of boilers, etc. (Six weeks.)

(i) Production, properties, expansion, and degrees of heat of steam.
(ii) Principal constitutive steam parts of the boiler.
(iii) Development of heat by combustion.
(iv) Principal fuels and their properties.
(v) Coal as an article of merchandise, procuration, conservation, cost.
(vi) Secondary fuels.
(vii) Furnaces, flues, producing and regulating air current.
(viii) Furnaces burning their own smoke and heating.
(ix) Principal parts of boiler.
(x) Manufacture, and building in, packing boilers.
(xi) Different types, advantages and disadvantages from a practical point of view, and from that of convenience.
(xii) Constructive part of the setting of boilers.
(xiii) Stoking. Regulating air draft, and instruction relating to supply of fuel. Questions as to ordinary and extraordinary demands on boiler.
(xiv) Saline matters, incrustation, cleaning, softening feed-water.
(xv) External and internal examination. Testing by water pressure. Principal defects. Most frequent repairs. Repairing. Explosion.
(xvi) State regulations concerning care of boilers.
(xvii) Practical demonstrations for all parts of the course.

Course II, for persons in charge of portable engines, thrashing machines. (Ten weeks.)

(i) General ideas of locomotives and their principal parts.
(ii) Production, properties, and expansion of steam.
(iii) Principal fuels, especially for locomotives.
(iv) The boilers of locomotives, and their manufacture.
(v) Packing and erection.
(vi) Rules as to stoking.
(vii) Heating by coke, wood, etc. Feed-water, previous heating, regulating air draft.
(viii) Initial attention to boiler, on provisory interruption, on definitive termination of use.
(ix) Cleaning, most frequent repairs.
(x) Government regulations.
(xi) Behaviour of steam in different parts of engine. Engine with ordinary valve. Cut-off of steam in various engines.
(xii) Compound engines and locomotives.
(xiii) Size, price, etc., of locomotives.
(xiv) Erection of locomotives. Work for mechanician for engine at rest and in service.
(xv) Theory of crank, connecting-rod, etc.; slide valves, etc. Principal defects of various parts. Repairs.
(xvi) General ideas as to thrashers; various kinds and systems. Steam thrashers. Details of those manufactured in Hungary
(xvii) Practical demonstrations.

Course III, for persons in charge of stationary engines. (Twelve weeks.)

(i) Steam and its properties. Superheating. Measurement of feed-water and fuel.
(ii) Softening feed-water.
(iii) Behaviour of steam. Advantages and disadvantages of expansion and compression. Parallelism between horizontal and vertical engines.

(iv) Point of cut-off of steam. Governors.
(v) Advantages and disadvantages of various forms of engine.
(vi) Corliss, Fricart, Collmann, Radowanovics, and Sulzer engines.
(vii) Single and multiple expansion. Woolf, tandem, and triplex machines. Advantages of compound engines.
(viii) Condensation, advantages and disadvantages.
(ix) Data as to consumption of steam, to practically evaluate it.
(x) Work of an engine. Mechanical work in horse power.
(xi) Indicators, construction and use. Principal defects remedied by use of indicator.
(xii) Energy of work.
(xiii) Bedding of steam engines—Stone, concrete, anchoring.
(xiv) Erection of steam engines.
(xv) Principal repairs.
(xvi) Lubrication, various lubricants, quality and testing. Central lubrication.
(xvii) Matters to attend to at commencement and termination of the day's work with engine. Starting.
(xviii) Demonstrations of practical work.

The above courses are very largely attended. The Higher School of Arts and Crafts at Budapest, has 790 students, who receive the course; the special school of Arad for wood and metal work has 68 students; and the similar school at Kolozsvár has 44, that is 902 adult pupils.

Such courses are now opened at Kassa, and Marosvásárhely.

36. *Course for Electro-technical Workers.*—This course consists of two divisions of about forty hours each. The details may be translated as follows:—[1]

Principles of electricity and magnetism.

Galvanic Cell. Coupling, E.M.F., intensity, resistance. Units. Conducting wires and insulation.

Magnets, magnetic fields, solenoids. Induction, various methods. Galvanoscope. Industrial instruments for measuring. Voltmeters, ampère meters, watt meters.

Continuous current dynamos. Simple dynamos, induction of current therein. Commutators. Constitutive parts of dynamo. Electro-magnets, their form and construction· Armatures, ring, cylinder, disc. Collectors. Brushes, holder, application. Multipolar dynamos. Excitation. Magnetisation by special source. Magnetisation by suitable arrangement of dynamos. Kinds of dynamos, characteristics. Construction, erection, maintenance of dynamos. Investigation of derangements. Cause of such.

Alternators. High tension currents. Properties of intermittent current. Principles of construction of alternators. Coupling coils. Polyphase alternators. Regulation and excitation of alternators.

Transformers. Transformation of electric current by induction coil. Ring transformers, their construction. Polyphase transformers. Installation and maintenance of transformers.

Accumulators. Secondary current. Various systems of accumulators. Charge, coupling, discharge, capacity, durability, installation, and maintenance of storage batteries.

Electric lighting. Incandescent lamps. Intensity of light, consumption of electric energy. Various incandescent lamps. Sockets. Arc lamps. Carbons. Electro-motive energy for arc lamps, consumption of electric energy. Length. Kinds. Arc lamps for continuous current. Intermittent current. Erection, columns, support of arc lamps Maintenance arc and incandescent lighting system. Derangements, their remedy.

Distribution of electric current. Coupling, for incandescents, for arc lamps. In series, etc. Mixed, systems of 2, 3, or more conduits.

Transmission of electric energy. Reversibility of dynamos. Electro-motive resistance. Electro-motors, various kinds. Starting and regulating electro-motors. Rotating magnetic field. Use of electro-motors. Use of electro-motors in machine shops, etc. Electric railways. Means of distributing currents. Earth return, ærial, by rails. Installation of electric motors in railway carriage, coupling with axle.

Telephones and Electric Bells. Telephones with magnet, with carbon, microphone. Electric bells with continuous current. Bells with intermittent current. Magnetic inductors. Various interrupters. Connecting bells Derangements and repairs.

Connecting and regulating apparatus. Interrupters. Lead foil, simple resistance, arc lamps, rheostats, self-acting resistances. Indicator of earth circuiting. Energy consumed. Electric meters. Horary measurements. Watts, ampères. Fuses in electric circuit.

Conducting wires, etc. Wires, cables. Insulators, simple, double. Installation of electric current, tools, work of installations. Wiring in interior of buildings, in open air, in damp places, underground cables. Lead cables. Systems of installation. Examination of circuits. Derangement, search for source of, repair:

Central Electric Stations. Connection with continuous current, dynamos, machines of intermittent current.

The lectures are treated from the practical standpoint, electricity and magnetism being handled in relation to electro-technics, and not from the standpoint of advanced physics. Everything is clearly explained, but without mathematical calculation. Special importance is attached to electro-magnetic theory and induction of current. The courses are illustrated by means of laboratory apparatus and by diagrams.

A considerable amount of questioning is done with a view of eliciting whether the matter has been thoroughly understood or not

37. *Course for Electricians.*—Another course for those who have to do with the installation of electricity is equally satisfactory. The course consists of lectures and practical work as follows:—

(1) Lectures. (2) Manipulation of dynamos, electric motors, lamps, etc. (3) Installation of electric circuits. (4) Practice in making electrical measurements. (5) Industrial drawing having relation to electric installations.

The course lasts five months, the hours per week for practical work for (2) to (5) being 8, 8, 6, 4 respectively. The fee is 16 crowns (say 13s. 4d.); examinations, 10 crowns (8s. 4d.); stamp for examination certificate, 2 crowns (1s. 8d.); the grades being three—excellent, good, satisfactory. Those who fail receive only a certificate of attendance.

The details of all the courses need not be stated in full; it will suffice to indicate only some parts.

The *Lectures* include the general theory of electricity and magnetism, dealing with continuous and polyphase current.

Theory of Instruments and Measurements.[2]—Principle. Various methods of measuring tension, intensity, resistance, great and small resistances. Various galvanometers. Electro-dynamic meter. Voltmeters. Ampère-meters. Watt-meters. Weston-instrument. Photometry. Measurements of cells, dynamos, motors, accumulators, incandescent and arc lamps, electric conductivity, insulation of circuits. Measurements at central station. Dynamos, electric motors, continuous current. Various constitutive parts and their functions. Multipolar dynamos.

Foucault currents, characteristic of dynamos, serving for lighting, transmission of energy, galvanoplastics, electro-metallurgy. Industrial utility and installation.

Alternators,

[1] In translating this the statement has been put in the briefest possible form.—G. H. K.

[2] In translating, much has been reduced or omitted, but sufficient has been given to give a clear idea of the completeness of the course.

Alternators, transformers, accumulators, electric lighting, distribution of electric current, transmission of electric energy, telephones and electric bells, regulating, electric conduction, etc., are treated much as in the previous course.

In addition, the principles of electro-metallurgy are treated. This covers the following :—

Principles of Electro-metallurgy.—The composition by elecritc current. Density of current. Electric sources. Installation and connections for galvanoplastic baths. Principles of electroplating. Soldering by means of electricity. Electric furnaces.

The practice in measurement and use of instruments is very extensive, and covers the whole range indicated in the lectures.

The constructive drawing bears upon the works of electric installations of various kinds, and a great deal is done.

About 170 pupils annually take the complete course, but in one year over 2,000 pupils took part of these courses in electricity.

38. *Industrial Schools for Young Women.*—Hungary possesses a number of industrial schools for young women affording general and also special instruction. The former includes *Hungarian*, embracing grammar and commercial correspondence, 1 hour a week being devoted thereto ; *arithmetic*, 1 hour a week for one semester ; *book-keeping*, 2 hours a week ; *freehand drawing*, from 2 to 4 hours per week.

The special subjects include section for "*lingerie*," drawing, and cutting-out, either by hand or with machines, repairing and trimming, hand-work ; a section for *dressmakers*, a section for *embroiderers*. one for *modistes*, who not only undertake millinery, but also manufacture artificial flowers.

39. *Lower Mining Education.*—The last section of technical education which seems to call for special reference is a form of elementary mining education. One of the most ancient mining towns of Hungary—"Selmeczbánya"—gives indications that mining education has existed for a very long period.

The instruction is given in a preparatory class, a common class, and two parallel classes, viz., one for *mining* and one for *foundry work*. The time-table hereunder will sufficiently illustrate the courses.[1]

Programme of Lower Instruction in Mining Exploitation at Selmeczbánya, etc., in Hungary.

Subjects.	Semesters, and Hours per Week.							
	I.	II.	III.	IV.	Mining.		Foundry.	
					V.	VI.	V.	VI.
Arithmetic	5	...	..	...	...	...	...	...
„ Practical exercises	4	...	...	...	...	...	...	...
Algebra	6	6	..	...	...	...	...	...
„ Practical exercises	4	4	...	...	...	...	...	...
Hungarian and literary style	2	2	...	...	...	...	.	...
„ Exercises	2	2	...	...	...	...	...	...
Caligraphy	3	2	2	3	...	...	...	...
Drawing	4	4	...	...	...	...	4	3
Quantity surveying	...	...	4	...	...	...	...	..
„ „ Exercises	...	...	2	...	...	...	...	...
Trigonometry	...	...	...	5	...	...	...	...
„ Exercises	...	...	...	1	...	...	...	...
Physics and mechanics	...	...	5	...		...		...
Mechanics	...	...	...	...	3	...	3	...
Chemistry	...	...	...	5	...	...	...	...
Study of projection	...	...	3	...	...	...	...	...
Freehand drawing and constructive design	...	...	4	...	...	...	...	...
„ plotting	...	...	...	2	...	...	...	...
Mining drawing	...	...	...	...	3	...	...	...
Mechanical drawing	...	..	...	...	2	...	2	...
Mineralogy and Geology	...	...	...	5	...	...	...	...
Exploitation of mines	...	...	...	...	7	...	...	...
„ metals	...	...	...	...	...	...	7	6
Preparation of metals	...	...	...	...	...	4	...	...
Mining legislation	...	..	...	...	2	...	...	...
Surveying and underground surveying	...	...	...	...	...	6	...	...
Plotting underground survey	...	...	...	...	...	2	...	...
Architecture and architectural drawing	...	...	...	...	...	5	...	...
Excavation	...	...	...	...	...	...	...	3
Hygiene	...	...	2	...	2	...	2	...
Book-keeping	...	...	...	...	...	2	...	2
Practical work	..	...	...	...	2	5	4	5

[1] The information has been obtained from an article by Ferencz Vnutskó, Higher Engineer for Mines.

The

The above programme represents the work of the mining schools of Selmeczbánya, Felsobánya, and Nagyág. The school of Verespatak is differently organised; its four semesters are occupied as follows:—

Programme of Lower Mining Instruction of Verespatak, in Hungary.

Subjects.	Semesters, and Hours per Week.			
	I.	II.	III.	IV.
Arithmetic...	5	5	...	...
Geometry	2	2	...	...
Mineralogy, petrography, and geology ...	2	2	...	...
Physics and kinematics	2	2	...	...
Constructive drawing, cartography	3	3	...	...
Hungarian	2	2	1	1
Caligraphy	2	2	1	1
Mining exploitation	...	...	6	6
Mining mechanics and drawing	...	...	2	2
" " " Exercises...	...	...	3	2
Underground surveying and drawing ..	...	...	2	2
" " " Exercises..	...	...	3	3
Mining legislation	...	...	...	2

40. *Concluding Remarks.*—The preceding sketch of what is being done in Austro-Hungary for technical education is wholly inadequate to convey the extent of the effort made for the industrial efficiency of the people. From what the Commissioners saw, it was obvious that progress was very rapid. All the recent developments seen afforded distinct evidence of an earnest progressive movement in education. Without exception, recent equipments seen in Austria, in Bohemia, and in Hungary, were excellent, and the prevailing opinion of educationists was that the industrial power of these countries would be greatly reinforced by the recent educational efforts.

A few examples of Hungarian buildings are given, as illustrating the material side of the educational provision made in Hungary.

SPECIAL SCHOOL FOR WOOD AND METAL WORKING AT ARAD, HUNGARY.

SPECIAL SCHOOL FOR WOOD AND METAL-WORKING AT SZEGED, HUNGARY.

SPECIAL SCHOOL FOR WOOD AND METAL-WORKING AT KOLOZSVÁR, HUNGARY.

HIGHER SCHOOL OF ARTS AND CRAFTS AT KASSA, HUNGARY.

SCHOOL OF DECORATIVE ARTS, BUDAPEST, HUNGARY.

CHAPTER XIII.

Lower Industrial and Technical Education in Belgium, Bosnia-Herzegovina, Bulgaria, Croatia-Slavonia, Finland, and Holland.

[G. H. KNIBBS.]

1. *Introduction.*—In order to appreciate the great advance in those forms of education which more immediately prepare for everyday activities, it is well to be able to compare the educational provision made by this State for its young people with as wide a field as possible. It is only in this way that it can be adequately realised that our educational provision is very far from being as satisfactory as it is in other countries. For this reason a brief reference will be made to the system of Technical Education in a number of countries.

BELGIUM.

2. *Technical Education in Belgium.*—The provision made in Belgium in the way of technical education is stated very briefly as follows :—

	Number of Schools or Courses.
I. Commercial and scientific courses ...	18
II. Higher technical institutions ...	13
III. Industrial schools ...	68
IV. "Professional" schools for boys, viz. :—	
(a) Apprenticeship "ateliers" and "professional" schools (of Flanders) for weaving...	39
(b) Apprentice ateliers for masons ...	20
(c) "Professional" courses ...	5
(d) "Professional" schools ...	31
(e) Schools of Saint-Luc ..	5
(f) Schools for industrial drawing ...	22
V. "Professional" schools for girls, viz. :—	
(a) School for housekeeping and domestic economy, etc. ...	296
(b) Apprenticeship "ateliers" ...	4
(c) "Professional" courses ...	3
(d) "Professional" schools ...	46
Total ...	570

Commercial and higher technical education will be dealt with in another part of the report.

3. *Aim of the Belgian Industrial Schools.*—The aim of the Belgian "*écoles industrielles*" is :—

(1) To afford workmen that scientific instruction which they cannot acquire in the workshop.
(2) To make workmen acquainted with those general laws which govern all transformations of matter.
(3) By the above means to develope the intelligence of the workman, and gradually to lift him above the "tyranny of routine."
(4) To enable him to advance the economic value of his work, and thus—
(5) To ameliorate his material condition.

It will suffice to indicate generally the method of such schools. The programme embraces :—

(i) *General theoretical courses*, viz. :—
(a) Arithmetic; (b) Geometry; (c) Physics; (d) Mechanics; (e) Hygiene; (f) Industrial economy.
(ii) *Special courses*, which correspond with local industries, viz. :—
(a) Chemistry; (b) Metal working; (c) Mechanics; (d) Civil engineering work; (e) Mining exploitation; (f) Electro-technics, etc., etc.
(iii) *Drawing*, which is also made of direct application to the calling of the pupil. The drawing is based upon the study of the projections of an object on three planes.

4. *Aim of Belgian Professional Schools.*—The aim of the "*écoles professionnelles*" differs greatly from that of the industrial school. While it does not neglect to inculcate the importance of that theoretical knowledge, which is essential to the best exercise of his calling, it keeps the practical education of the pupil, in his calling, primarily in view. It is akin to the industrial school combined with an apprenticeship "atelier." The aim of such schools may therefore be said to be :—

(1) To afford a practical education to various occupations.
(2) To make young people and workmen familiar with the most recent, perfect, and advantageous processes in their callings.
(3) To raise the economical level and material condition of the workmen.
(4) To enable workmen to pass readily from one calling to another, which is often necessary owing to great industrial transformations.

5.

5. *Belgian Professional Schools for Young Women.*—The instruction in the "*écoles professionnelles pour jeunes filles*" is (I) general, and (II) special. The general and obligatory portion consists of :—

(1) Mother-tongue; (2) Arithmetic; (3) Commercial science; (4) History; (5) Geography; (6) Caligraphy; (7) Natural sciences; (8) Education; (9) (Hygiene; (10) Domestic economy; (11) Drawing; (12) Manual work.

The professional portion varies with the locality of the school. Actually the following subjects are taught, viz. :—

(a) Drawing in general; (b) Drawing of lace designs; (c) Painting upon porcelain and faïence; (d) Painting on glass; (e) Painting on fans, and on materials; (f) Dressmaking; (g) Embroidery; (h) cutting-out and confection; (i) Lingerie; (j) Manufacture of artificial flowers; (k) Modes; (l) Corsets; (m) Commerce.

The courses last usually from three to four years. *Quality, not quantity* of work is insisted on in the practical work.

6. *Belgian Apprenticeship "Ateliers."*—The creation of the "*ateliers d'apprentissage*" arose largely from the great transformations at the end of the 18th and beginning of the 19th century in industry in general, and particularly in the linen industry. Apprenticeship became difficult, and in 1834 protective laws were established with a view of arresting the decadence of that industry. *But experience shewed that that measure was inadequate.* In 1840 the Government, at the suggestion of the "*Association nationale pour le progrès de l'ancienne industrie linière,*" commenced an inquiry as to the remedies for the unsatisfactory state of things, and *inter alia* they recommended the opening of schools of apprenticeship (*écoles d'apprentissage*) for various trades and callings, *at the public cost.* By way of experiment the Administration established several "ateliers" in which new processes of weaving were taught practically, and in which improvements to which the processes were susceptible were demonstrated.

The excellent result of these experiments shewed how to re-establish the decadent industries, and how to achieve what the protective measure utterly failed to secure.

The Government made an appeal to proprietors of industrial establishments, and promised subsidies, and the "*ateliers d'apprentissage*" were established by an "*arrêté royal*" of 26th January, 1884.

7. *The Belgian Housekeeping Schools.*—In 1888, Belgium had only two "*écoles et classes menagères*"; twelve years later, however, this number had increased to 296 with over 11,000 pupils. The industrial and economic conditions of the country had made it clearly impossible for the average young woman of Belgium to discharge her family duties satisfactorily.

The instruction consists of :—

I. Theoretical courses, viz. :—
   (a) Hygiene. (b) Domestic economy. (c) Care of children. (d) Care of the sick.

II. Practical exercises, viz. :—
   (a) House-keeping, proper care of furniture. (b) Washing and ironing of linen. (c) Needle-work; cutting-out and making of ordinary clothes; repairing of linen and clothes. (d) Cooking. (e) In rural districts, care of the kitchen-garden, and poultry yard.

The House-keeping schools (*écoles menagères*) are schools in the strict sense, and pupils attend for the entire day. The classes (*classes menagères*), on the other hand, are courses given on the subject but both have practical work.

8. *Industrial and Special Professional Schools.*—As an example of the higher class of such schools the "*Ecole supérieure de textiles de Verviers,*" and the "*Ecole industrielle de Verviers,*" two schools housed in one building, may be taken.

The course of instruction lasts four years, and covers (a) Chemistry; (b) Dyeing; (c) Botany of textile materials; (d) Mechanical weaving; (e) Construction of machines; (f) Electro-technics; (g) Physics; (h) Geometry; (i) Industrial architecture; (j) Accountancy; (k) Industrial economy; (l) History; (m) Commercial law; and (n) the German and English languages.

The material equipments of everyone of the Belgian technical schools seen by the Commissioners were on a large scale and were very complete. Among these may be mentioned the "*école industrielle*" of Ghent, where there were about 1,000 day pupils, and counting evening and Sunday pupils, about 3,000. There is an elaborate course for weaving and dyeing, and the equipment for this was on a lavish scale.

Bosnia-Herzegovina, Bulgaria, etc.

8. *Technical Education in Bosnia-Herzegovina, Bulgaria, etc.*—Such countries as the above are providing technical education in order to raise the level of their industrial efficiency.

The programme of the "Arts and crafts" school of Sarajevo, in which over £4,000 per annum is spent, will give some idea of the type of education.

Programme

[1] The Belgian Government takes a decided view as to the moral effect of this instruction. In a public report it is said (the translation given by the Commissioner is literal) :—"It is not surprising that the new household, established under such unfavourable conditions," viz.,—those arising from the young wife's ignorance—"should soon present a spectacle of the greatest moral and economic disorder. The resources are squandered, the habitation and the furniture are badly looked after, the children are without the necessary moral and physical care, the meals are hastily and badly prepared. Soon the head of the family, instinctively repelled by the permanent disorder of his home, yields to the temptation of the tavern and the invitations of his comrades. Then the family morale is dissolved. Affection is extinguished by continual disputes, and as they grow up, the children, left to themselves and educationally neglected, tend to be alienated from the home,—a hearth where nothing occurs to gladden their eyes nor to make their souls serene. . . . . . The family is the basis of society : the consequences of the situation are perceived without difficulty."

Programme of the School of Arts and Crafts of Sarajevo, Bosnia-Herzegovina.

Subjects.	Years, and Hours per Week. I.	II.	III.	IV.
Religion	2	2	2	2
National Language (with compositions on business subjects)	4	3	3	2
Calculation, including commercial calculation and book-keeping	5	5	4	2
Writing	4	...	...	...
Physics	2	In the teaching of the National language, a certain number of reading selections bearing on Physics.		
Strength of Materials and Technology	...	2	Same remark as above.	
Freehand Drawing	6	5	"	"
Geometry and Geometrical Drawing	6	...	"	"
Theory of Drawing of Projections...	...	3	"	"
Special Drawing	...	4	8	8[1]
Technical and Workshop Practice...	17	24	34	36
Total	46	48	51	50

The "practical" portion of the teaching in the workshops, refers to joinery and cabinet-making, carriage building, locksmithing, etc., and metal work generally. The special national skill of Bosnia in incrustation and marquetry work, damascening, chasing, engraving, carpet-weaving, and embroidery is incorporated into the work of the technical schools,[2] and special workshops have been erected, viz.:—

A central workshop school at Sarajevo,
Workshops for "incrustation," at Foca and Livno,
Workshops for embroidery and carpet weaving, at Sarajevo.

Ten hours per day are devoted to work, two being occupied by general supplementary education, and eight by practical instruction in the calling selected.

9. *Technical Education in Bulgaria.*—Bulgaria has practical schools of industry, of which the following may be taken as examples, viz.:—

(1) Weaving and dying, at Slivno.
(2) Blacksmithing, forge work, etc., at Samakow.
(3) Joinery and cabinet-making, at Routschuk.
(4) Pottery and ceramics, at Trn.

There are also "professional" schools for women.

CROATIA–SLAVONIA.

10. *Technical Education in Croatia-Slavonia.*—On 30th May, 1886, a law creating *apprentice schools* was promulgated, and these received a definitive constitution in 1892. The duration of attendance is three years. There are now over 5,000 pupils in such schools.

Besides these, there are a number of *special industrial* schools. These include, for example, such trade courses as are given in the school of basket-making of Osijek; the school for joinery and cabinet-making, wood-turning and carving, at Otočac; the wheelwrights' school, Lika, etc.

In the Royal School of "Arts and Crafts," at Zagreb, locksmithing, joinery and cabinet-making, wood-carving, wood-turning, sculpture, decorative painting, and masonry, are taught. The industrial school has two sections, viz.:—

A *workshop school* and a *school of architecture*. The course is four years in the former, admission taking place between the ages of 12 and 15.

The architectural school has two divisions, viz., one for professional architects, the other for builders, building contractors, overseers of architectural works.

Pupils entering the higher division, must have passed through four classes of a secondary school or of an industrial school. They study the following subjects in the school, viz.:—

(1) Mother-tongue; (2) German; (3) Geography; (4) History; (5) Mathematics; (6) Descriptive geometry, perspective, including the treatment of shadows; (7) Physics; (8) Chemistry and chemical technology; (9) Architecture in general; (10) Architectural plans; (11) Special architecture (civil, economic, and industrial buildings); (12) Theory of Architectonic forms and study of style; (13) Architectural administration, book-keeping, special to laws relating thereto; (14) Architectural mechanics; (15) Surveying; (17) Technical drawing; (19) Free-hand drawing; (20) Modelling; (21) Caligraphy, etc.

The school for builders, etc., has three special courses, viz.:—

(I) Architectural masons, foremen of works, draftsmen.
(II) Masonry in all branches.
(III) Carpentry in all branches.

Each course lasts four winter semesters, from 1st November to 31st March.

Industrial education for women includes, courses in dressmaking, lingerie (hand and machine work), hat making, knitting, ironing, etc.

FINLAND.

[1] For smiths special drawing is replaced by the theory of shoeing and by special exercises.
[2] This is due to the efforts of O. Szentgyörgyi of Budapest and Prof. Storch.

FINLAND.

11. *Technical Education in Finland.*—While technical education is not well advanced in Finland, sound beginning has been made by the manual training (Slöjd) in the elementary schools, and it may be observed that the recent advance is considerable. Finland has *industrial schools* at Helsingfors, Kuopio, Nikolaistad, Tammerfors, and Åbo. The courses are for mechanics, metal-working, electro-technics.

Throughout the larger number of the lesser towns of Finland there are evening "professional" schools, in which reading, writing, arithmetic, book-keeping, and drawing are taught.

In the larger towns such schools also exist, with similar courses of a more advanced character, and in Helsingfors there is further a "central school of artistic industries."

12. *The Polytechnic Institute of Finland.*—The Finnish Polytechnic, locally known as "*Suomen Polyteknillinen Opisto*" (*i.e.*, Suomi's Polytechnical College), in Swedish, Polytekniska Institutet i Finland, had its origin in a technical school founded in 1849.[1] It is a higher technical school, that is to say, one of university grade, with four-year courses in architecture, civil engineering, mechanical engineering, chemical technology, and land surveying (*Maanmittausos*, in Finnish). This will be referred to later in the Report.

HOLLAND.

13. *Technical Education in Holland.*—The Trade Schools of Holland have been referred to in Chapter XI.[2] It is proposed here to outline the general scheme of technical education in Holland.[3]

Excepting the higher institutions, schools for technical instruction are classed under middle schools (*Middelbare Scholen*). They are very variously organised, and variously named. The following list will give a general idea of the variety of the schools. The schools mentioned are selected from the lengthy official list.

List of some of the Technical, Trade, and Industrial Schools of Holland.
(Teekenscholen, Ambachtsscholen, en andere Technische scholen.)

Commune.	Name of School.	English Equivalent.	Subjects Taught.	No. Teachers.	No. Pupils.
's Hertogenbosch	Koninglijke school voor nuttige en beeldende kunsten	Royal School for useful and fine arts.	Freehand, linear, and ornamental drawing, modelling, architecture, painting.	11	219
Breda	Teekeninstituut ...	Drawing Institute	Freehand, linear, mechanical and architectural drawing and modelling.	13	490
Arnhem	Teekenschool van het Geenootschap "Kunstoefening."	Drawing school of "Art-practice" Association.	Freehand and linear drawing, theory of projection, perspective, anatomy, architectural styles, modelling, decorative art.	5	194
Wageningen ...	Teekenschool voor aankomende werklieden.	Drawing school for young workers.	Freehand, linear and architectural drawing, theory of projection, decorative painting, graining, marbling, arithmetic, Dutch language, and natural philosophy.	10	103
's Gravenhage ...	Academie van beeldende kunsten.	Academy of fine arts.	Freehand, linear, architectural and ornamental drawing, painting, modelling, technical drawing, perspective, geometry, methodology.	47	819
's Gravenhage ...	Avondteekenschool voor volwassen handwerkslieden	Evening drawing-school for adults.	Freehand, linear, architectural, furniture drawing, arithmetic, geometry, physics and chemistry, theory of projection.	7	37
Brielle	Ambachtsteekenschool	Trade-drawing school.	Freehand, linear, architectural, and industrial drawing, theory of projection, geometry.	4	46
Amsterdam ...	Avondteekenschool voor handwerkslieden.	Evening drawing school for manual workers.	Freehand drawing, industrial drawing for the various trades, modelling, painting, etc.	27	554
Amsterdam ...	Industrieschool van de Maatschappij voor den werkenden stand.	Industrial school of the Society of Workers.	Freehand, linear and architectural drawing, modelling, workshop knowledge, mathematics, electricity, etc.	13	166
Amsterdam ...	Teekenschool voor kunstambachten.	School of drawing for the Artistic industries.	Freehand, linear and architectural drawing, modelling, industrial drawing, and drawing from Nature, perspective, etc.	13	350
Amsterdam ...	Kweekschool voor machinisten.	Seminary for Mechanics.	Mathematics, workshop knowledge, natural science, drawing, handicrafts, book-keeping, English, German.	21	175
Haarlem... ...	School voor kunstnijverheid.	School for Art-industries.	Freehand, linear, architectural, and ornamental drawing, modelling, decorative painting, theory of projection, recapitulation.	13	218
Purmerend ...	Teekenschool... ...	School for drawing.	Freehand, architectural, and plaster model drawing, arithmetic, geometry, perspective.	6	59
Leeuwarden ...	Teekenschool voor volwassen ambachtslieden en vrouwelijke leerlingen.	Drawing school for adult handicraftsmen and female students.	Industrial drawing	5	125
Groningen ...	Avondschool voor ambachtslieden.	Evening school for handicraftsmen.	Freehand, geometrical, and architectural drawing, modelling, mathematics, Dutch language.	14	200

There are between eighty and ninety of such schools as the above.

List

[1] See "Kort historik öfver polytekniska institutets i Finland uppkomst och utveckling. E. Qvist, Helsingfors, 1899.
[2] By Mr. J. W. Turner.
[3] For a general report of the schools of the Netherlands, see Verslag van den Staat der Hooge—Middelbare en Lagere Scholen in het Koninrijk der Nederlenden, over 1900-1. 's Gravenhage, 1902.

List of some of the Housekeeping and Industry Schools of Holland (Huishoud-en Industriescholen).

Commune.	Name of School.	English Equivalent.	Subjects taught. Theoretical.	Subjects taught. Practical.	Length of course.	Teachers.	Pupils.
					Yrs.	No.	No.
Amsterdam	Industrieschool voor vrouwelijke jeugd.	Industrial school for young women	Drawing, Dutch, arithmetic, book-keeping.	Dressmaking, art needlework, hand and machine sewing, etc.	3	24	282
Rotterdam	Industrieschool voor meisjes.	Industrial school for girls.	Drawing, Dutch, arithmetic, book-keeping, French, hygiene, pædagogy, geometry, geography, general history, composition, history of art, caligraphy.	Dressmaking, art needlework, hand and machine sewing, elementary examination in useful manual work, ironing, gymnastics.	3	22	213
Arnhem ...	Industrieschool voor meisjes.	Industrial school for girls.	Drawing, Dutch, French, arithmetic, book-keeping, hygiene, commercial knowledge, pædagogy, industrial and artistic handwork, geography, caligraphy.	Dressmaking, art and ordinary needlework, machine-sewing, repairing, marking, crotchet work, knitting, etc., ironing.	5	15	155
Alkmaar ...	Huishoud-en Industries school.	Housekeeping and Industrial school.	Drawing, Dutch, arithmetic, book-keeping, commercial knowledge, hygiene, French, English, pædagogy.	Dressmaking, art needlework, cooking, ironing, housekeeping, Fröbel occupations, Sloyd, etc.	3	22	178 51[1] 170[2]

List of some of the Trades or Crafts Schools of Holland (Ambachtsscholen).

Commune.	Subjects Taught (Theoretical).	Subjects Taught (Practical).
's Hertogenbosch	Linear, and architectural drawing and details. Building materials.	Carpentry.
's Gravenhage ...	Freehand, linear, ornament, architectural, and mechanical drawing, natural science, workshop knowledge, steam engine—theory, arithmetic, practical geometry, Dutch, history of industry, State laws, technology.	Carpentry, furniture-making, carving, masonry, painting, house and machine construction, copper, tin, zinc, and lead working, instrument-making; also, special, wood-turning, pattern-making, modelling, decorative painting.
Rotterdam ...	Continuation of lower education, mathematics, workshop knowledge, natural science, theory of steam-engine, electro-technical, freehand, architectural, ornament, and industrial drawing, knowledge of materials.	Carpentry, cabinet and furniture making, sculpture carving, etc., house-painting, needlework, forge-work, instrument-making.
Leiden	Freehand, linear, industrial, and geometrical drawing, theory of steam-engine, modelling, knowledge of materials.	Carpentry, cabinet-making, house building, forge-work, machine-shop practice, turning, house-painting, modelling.
Amsterdam ...	Freehand and industrial drawing. Continual of lower education, recapitulation. Building materials, tools in the widest sense, so far as they apply to the trade of the pupil.	Carpentry, painting, furniture-making, turning.

The above are sufficient to shew the type of work done in the "*ambachtsscholen.*" The courses are usually of three years' duration except in Amsterdam, where they are of two years' duration.

It is obvious that, as elsewhere, *drawing* plays a conspicuous part in all the technical schools.

14. *Day Apprentice Schools of Holland.*—The "Ambacht" school of Amsterdam was established in 1861, most of the others in about 1870. It is mainly to private initiative that they owe their development. Their incomes are derived from endowments, donations, and from subsidies from State, province, or commune. They embrace *practical instruction* in carpentry, joinery, cabinet-making wood-turning and carving; forge-work, ordinary engineering shop work, metal work in iron, copper, bronze, tin, lead, etc.; masonry, building trades, etc.; but the courses vary in different schools.

The *theoretical work* is of two kinds, work which is essentially a continuation of the instruction received in the elementary school, and work which has a direct relation to industrial efficiency.

Pupils enter ordinarily between 12 and 13, and (say) up to 15 years, and leave, therefore, between 15 or 16 up to 18.

Pupils going from one school to another are placed as near as possible in the same class.

An inspector was appointed for the first time in 1889.

15.

Special courses. [2] Eveni courses.

15. *Evening Apprentice Schools of Holland.*—In many of the communes there are schools for workmen or apprentices, open in the evening, usually for the winter months only. Drawing, as the lists given shew, occupies the chief place, mathematics and the mother-tongue occupy a lesser place, and other branches respond to local needs.

16. *Technical Instruction for young women, Holland.*—It will be seen that the work is of two kinds, viz., (*a*) needlework in its ordinary and artistic forms, dressmaking, etc., a continuation largely of what originates in the elementary school; and (*b*) *housekeeping*, *cooking*, washing and ironing, etc. The latter schools have existed for about twenty years.

The work of this character is *exceptionally* good, and the courses and equipments for teaching well-nigh perfect, where the Commissioners had an opportunity of seeing them.

17. *General remarks on Technical Education in Netherlands.*—The technical education of the Netherlands is largely private, with State and communal (or municipal or shire) subsidy. It is usually *not* free, but fees are low. There are small bursaries, and two or three schools are free. Generally speaking, they respond to local needs, and the value of more systematic education in handicrafts and technology is being more and more clearly recognised, and more and more definitely responded to. The "Ambachts," or trade schools, are often very well organised, both as regards material and personnel.

CHAPTER XIV.

CHAPTER XIV.

Trade Schools of Holland.

[J. W. TURNER.]

Introduction.—The very practical character of the teaching in Holland was witnessed in the Ambachtsschool (Crafts and Professional School), the Hague, where 300 boys, from 13 to 16 years of age, were undergoing a three-years' course of training under the supervision of a staff consisting of twenty-four professors and teachers. The boys, at the time of the Commissioners' visit, were occupied in iron and wood work and the trades connected therewith, and their constructive ability was noticed in the erection of new buildings intended for the installation of electricity. The chief aim of the school appeared to be the making of practical engineers.

The following history of the Hague "Trade" School is a translation of a report published by the Director in 1898:—

Review of Twenty-five Years' Existence of the "Trades School" at the Hague.

In the course of the year 1898 the "Trades School" will have been established for twenty-five years. At the request of the Editor of *The Hague Year Book*, I have endeavoured in the following to give a review of that period.

As far as I could trace, the establishment of a trades school was first discussed in public at a meeting of the "Association for the Advancement of the Builders' Art" at the Hague.

Thereafter, a separate body was formed, consisting of "member-shareholders," under the title of "The Hague Trades School." The association was constituted for a period of twenty-nine years by Royal assent of June 14th, 1872.

The promoters chose a provisional committee, consisting of twenty-one (21) gentlemen, who instructed a sub-committee of seven (7) members to carry out preliminary measures. Amongst these the following are to be remembered:—

1st. The purchase of a suitable building in January, 1873, which, in the summer of that year, was fitted up for its new work.

2nd. The appointment of a "Director-Teacher," which I had the honour to take up on August 1st of the same year.

3rd. The compiling of a syllabus, to which the then Inspector of Secondary Education lent his valued co-operation.

The cost of purchasing the school-buildings (including Director's dwelling) amounted to £2,083 6s. 8d., which was covered by sums of quite £1,125 raised by voluntary contributions, the balance being made up by mortgages, while from the annual private contributions, provincial and municipal subsidies, school fees, etc., purchases of necessary goods for teaching purposes, salaries, etc., were obtained.

At the commencement the school curriculum comprised repetition and extension of primary education, freehand and mechanical drawing, practical instruction in carpentry, joinery, blacksmithing, and decorative painting.

For this purpose nine teachers were engaged, five of whom taught the theoretical subjects and drawing, four teachers taking the practical classes.

The school was opened on 11th September, 1873, with forty-one out of sixty-eight pupils who had made application for admission. Such was the humble and uncertain beginning!

In 1877 the first pupils of the school entered upon the practice of their various trades. The management of the school had so timed the termination of the course of instruction as to coincide with the greatest demand for workmen. In spite of this, it was found difficult to ensure each pupil a position where his capabilities would be fairly tested. With a few notable exceptions, the pupils were shunned by their fellow workmen, and given work otherwise only entrusted to men of longer years of experience. Their theoretical knowledge, such as they possessed above other workmen of that time, was looked upon as useless.

With the object of making the usefulness of the school better known, annual public exhibitions were arranged, comprising drawings and other works of the students. Simple articles of furniture, and making of models for teaching purposes for other schools were undertaken, as well as the execution of small private orders which were of such a character as not to compete with any outside manufacture.

Only such orders could be taken as were in their execution instructive to the students; all orders were charged for at the current market rates. The profits arising from such work—a small sum as compared to the expenditure in the interests of the students—were in part returned to the student—that is, were placed at the disposal of his parents or guardians; and it will be readily understood that under these conditions the best stimulus for the best efforts was offered. In spite of all these conditions, many objections were raised to this system by opponents of the school.

By a gradual extension the subjects taught in the school included wood-carving, wood-turning, metal-turning, copper and tin smithing, working in lead and zinc, instrument making, stone-masonry, clay-modelling, and decorative painting.

Arrangements were made for the accquirement of proficiency of various trades outside the school.

A municipal contribution of 10,000 guilders, or £833 6s. 8d., was devoted to effecting improvements in school buildings, so as to make possible the proper training of engine-drivers for the smaller industries.

In the meantime the school had made steady progress, but, in spite of ten years' work, was not known sufficiently among those whom it was intended to benefit. Lectures and demonstrations on the work of the school were accordingly arranged for working men, with the result that, in 1883, 131 pupils were on the roll, as compared to less than 100 the previous year.

During September of 1882 the tenth anniversary of the school's establishment was celebrated, in the presence of several Ministers of the Crown, Mayor and Aldermen, and representatives of various schools. The annual exhibition was opened, prizes distributed, and members of the National Singing School for Workmen contributed to the evening's enjoyment.

A list of past pupils of the school showed the following results :—

Those who left the school up to 1884 with certificate for a three years' course, numbered 93. 467 students had attended, some leaving without certificates, others not finishing their course. Of the 93 before mentioned, 42 had entered upon their trade as ordinary workmen. Two of these were later on employers, 8 others "overseer-draftsmen," and 5 entered military service, while 16 immediately were recognised to combine the qualities of good workmen and draftsmen. The 27 others who obtained certificates could not be traced ; but in all probability remained ordinary workmen.

In order to assist those whose work was not practically taught at the school, arrangements were completed with well-known masters in the following trades to take pupils : Bookbinding, printing, cardbox making, bootmaking, tailoring, coopering, carriage building, piano making, stone-masonry, basket making, horse-shoeing, gold, silver, and other precious metal work. In some of the above-mentioned subjects pupils could take their first and second years' courses at the school, while others took only theoretical and drawing instruction there.

A National Exhibition was held at the Hague, in 1885, where competitions were open for different tradesmen, and for Trade School pupils who secured the following distinctions :—

First prize.—For modelling and wood-carving in general.
First prize.—For wrought-iron lectern, excelling in forged, turned, punched and filed ironwork.
First prize.—For painting of imitation mosaic, and various kinds of wood and marble.
Second prize.—For collective joinery exhibit, including roof and model stairs construction.
Third prize.—For cooking range and coal-scuttle.

Medals were awarded to the school, while the students who had taken part in the work on the successful exhibits each received a diploma. Votes of thanks were passed to many corporations, factory-owners and managers and others for their co-operation and interest in providing excursions for students to the following places of interest :—

Steam sawmills.
Steam furniture factories.
Public and other buildings during construction.
Museums.
Exhibitions.
Sash and door factories.
Electroplating works.
Margarine factory.
Fire brigades stations.
Girls' industrial school.
Porcelain and earthenware factory.
Gas-engine works.
Windmills.
Meatworks.
Ironmills.
Zinc factory.
Breweries.
Swimming-baths.
State workshops.

At the conclusion of these "excursions," drawings were made and compositions written by the students.

In 1893 a fund was started with the following ends in view :—

1st. To award one or more special annual prizes for the best pupils in the school.
2nd. To assist aged or invalided teachers of the school if necessity should require.
3rd. To assist very promising and unfavourably placed pupils after completion of their course.

Many gratuitous services had been rendered yearly to the school.

One gentleman, for a number of years, supplied all the plaster of Paris used in the modelling rooms, as well as many plaster casts presented as models. Another firm supplied quantities of cast and wrought iron for students' use.

Many suppliers of materials gave their goods at 10 per cent. and 20 per cent. discount, others at cost price.

Yearly subsidies from the city, the Province of South Holland, and the State amounted to 10,000, 2,000, and 8,000 guilders respectively.

List of Articles presented.

A bench vice.
Technological books.
Samples of marble (to imitate).
Model of pile-driving gear.
Old Dutch lock.
Model waterworks.
Models of factories.
Collection of timbers (all parts of world).
Large collection of different bricks.
Large collection of steel and iron plates, rods, &c.
Lathe and collections of tools.
Asbestos samples.
Collection electrical apparatus.

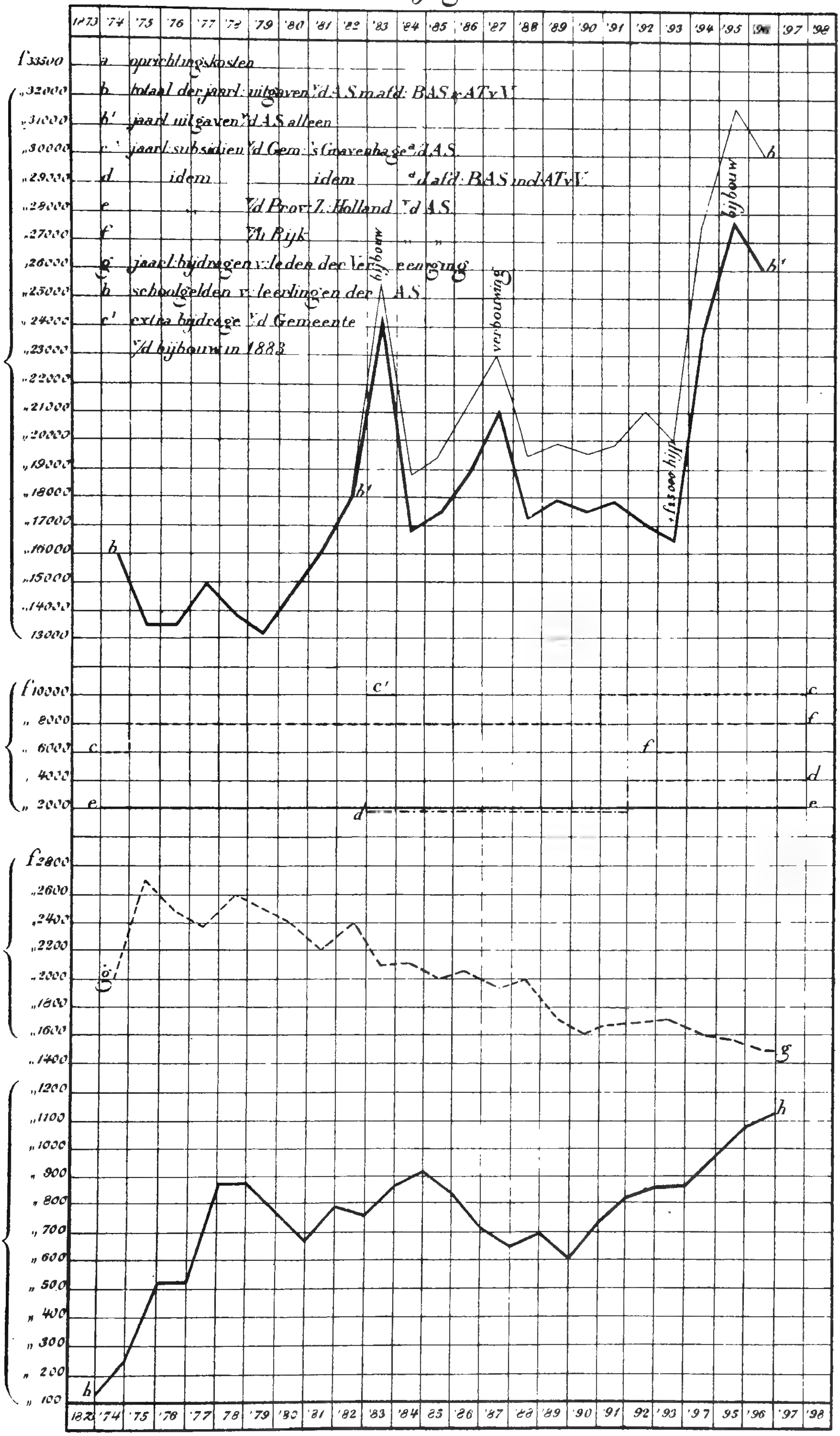
Complete List of Subjects Taught.

Drawing—Architectural, mechanical.
Arithmetic, mathematics.
Dutch language, singing, history, geography.
Natural science—Chemistry, physics.
Blacksmithing.
Carpentering.
Freehand and ornamental drawing.
Cabinet-making.
House painting.
Pattern-making.
Wood-turning.
Gold, silver, copper, lead, zinc work, &c.
Instrument-making.
Clay-modelling.
Wood-carving.
Materials and tools.
Stone-carving.
Metal-turning, planing, &c.

It is gratifying to note the increased number of students attending the school whose parents are members of different workmen's societies. (See following table.)

	1873–83.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
General Workers' Union of the Hague	8	6	10	11	17	12	13	12	17	17	22	27	28	15	10
Dutch National Workers' Union	...	...	...	2	2	3	4	2	2	3	3	5	4	3	1
Jewish Trades Union		...	...	2	4	6	8	4	5	5	7	8	10	14	15
Christian Peoplesbond	...	...	...	...	...	...	...	...	..	...	5	5	3	5	2
Freemason's Lodge—" l'Union Royale"	1	...	...	...	...	...	1	1	1	...	...	...	...	...	...
" Armenzorg" Society (Care for the Poor)	...	...	...	...	...	...	...	...	...	2	10	10	15	17	19
City Council of the Hague	3	7	10	8	5	3	4	6	6	7	8	14	10	7	4
Members of " The Trades School Society"	2	4	4	3	2	2	3	3	2	1	3	2	2	2	3

Bijlage IV[a]

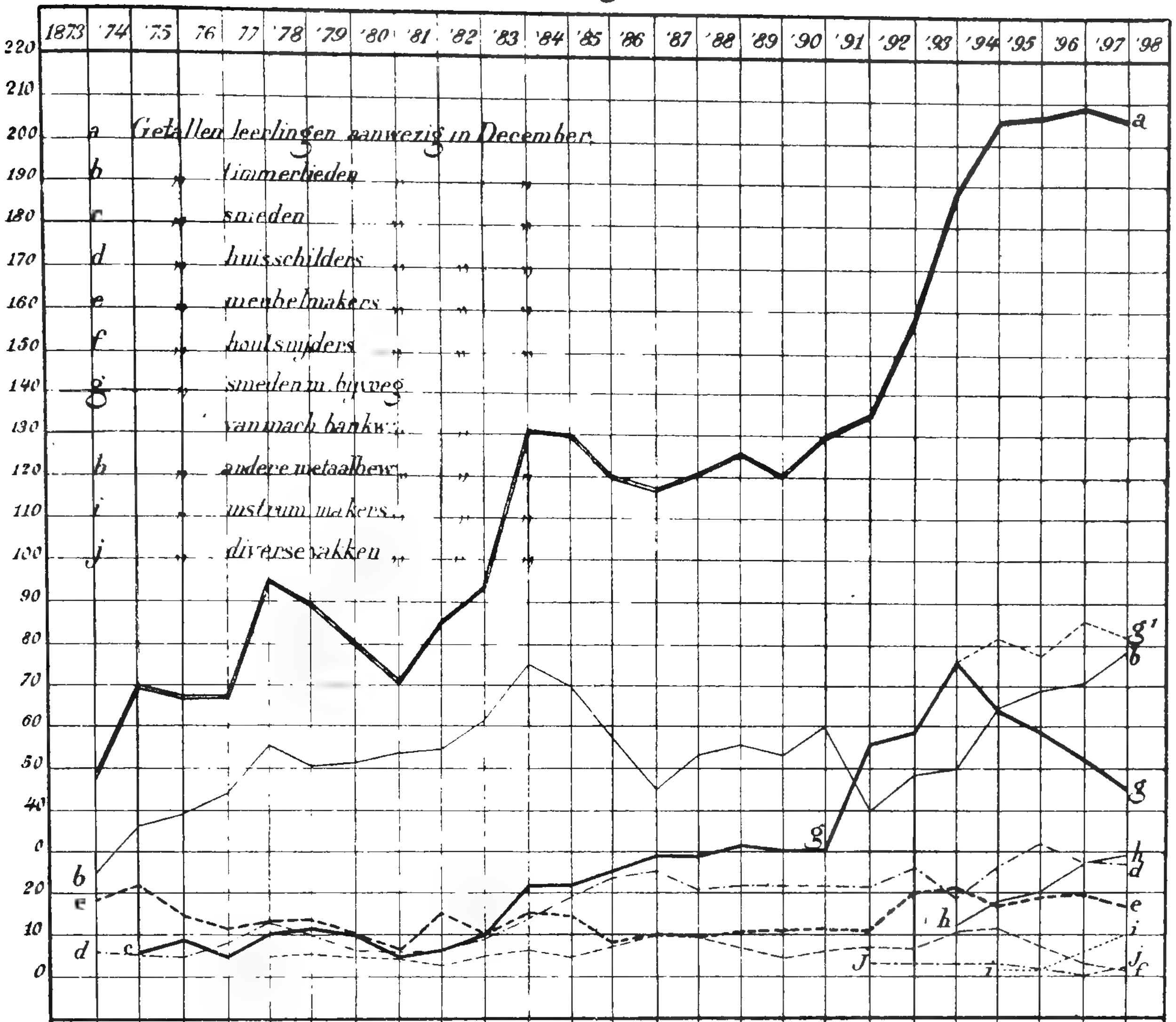


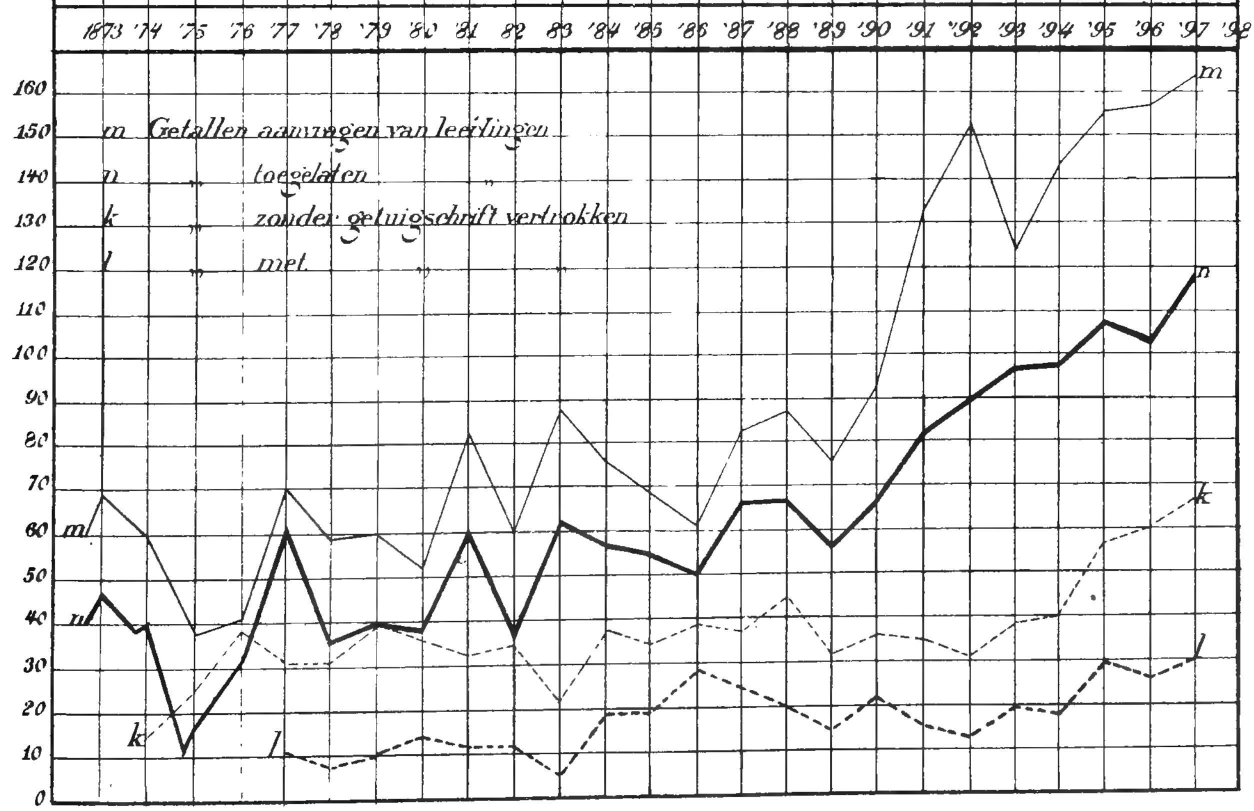
Bijlage IV B

50985

Photo-lithographed by
W. A. Gullick, Government Printer,
Sydney, N.S.W.

Bijlage V^B





50985

Bijlage V^c

Photo-lithographed by W. A. Gullick, Government Printer, Sydney, N.S.W.

Key to Graphic Diagrams.

Bylage IVA.

a. Original cost of establishing Trades School.
b. Total yearly expenditure for Trades School, and evening classes for adults.
b[1]. Yearly expenditure on Trades School only.
c. Annual subsidies from the Hague City Council.
d. Annual subsidies from the Hague City Council for evening classes for adults.
e. Annual grants from Provincial Council.
f. Annual grants from Parliament.
g. Annual contributions from members of Association.
h. School-fees received for Trades School.
[1]. Extra grant from City Council for extension of School in 1883.

Bylage VB.

a. Number of Students in Classes in December.
b. Number of Carpenters in Classes in December.
c. Number of Blacksmiths in Classes in December.
d. Number of House-painters in Classes in December.
e. Number of Cabinetmakers in Classes in December.
f. Number of Woodcarvers in Classes in December.
g. Number of Blacksmiths and Metal-turners in Classes in December.
h. Number of other Metal-workers in Classes in December.
i. Number of Instrument-makers at School in December.
j. Number of various Trades at School in December.
m. Number of Applicants for tuition.
n. Number of Applicants admitted.
k. Number of Students left without full certificate.
l. Number of Students left with full certificate.

Programme of Lessons during the Winter Term of 1897–98. *During the Summer Term work commences at* 7 *a.m.*

Subjects Taught.	Monday.				Tuesday.				Wednesday.				Thursday.				Friday.				Saturday.		
	8–10	10–12	2–4	4–6	8–10	10–12	2–4	4–6	8–10	10–12	2–4	4–6	8–10	10–12	2–4	4–6	8–10	10–12	2–4	4–6	8–10	10–12	2–4
Dutch Language					2c		2a			2b			1d	1e				1a					1b
Arithmetic										1b				1a			1d	1c					
Practical Geometry	2c		2a								2b				2b				3		3b		
Natural Science and Mechanics															3				2bc				2a
Steam Engineering			2b						3b														
Electricity																							3b
Chemistry—Technology		3a																					
Political Economy																						3	
History of Trades																						3	
Projection									2												3		
Freehand Drawing	1a 3b	2b		1d 3a	1a 3b	2b		1d 3a	1a			1d	1c 2a			1b 2c	1c 2a			1b 2c	1c	1b	
Line Drawing	1c		2b	1b	1a			1b	1a 2a			1b 2c											
Architectural	2a				2a											3a				3a			
Mechanical				3b			2b	3b				3b				2b				2b			
Various Trades *				2c				2c	2c 3b			2c 3b									2a 3a	2b	2a 3a
Study of Materials and Tools *																							1 2
Clay moulding*														2 3				2 3					2 3
Carpentering	1b 3	1 2	1 2 3	1a 2	1b 3	1 2	1 2 3	1a 2	1b 3	1a 2 3	1 3	1a 2	1b 3	1b 2 3	1 2	1a 2	1b 3	1b 2 3	1 2	1a 2	1b	1a 2	1a
Wood-turning	3				3																		
Pattern-making	1				1					2 3													2 3
Cabinetmaking	1	1 3	1 2 3		1	1 3	1 2 3		1 2 3	2 3	1 2 3		1 2 3	1 2 3	1 2		1 2 3	1 2 3	1 2		1 2	2	2 3
Wood-carving	1	1 2 3	1 2 3		1	1 3 3	1 2 3			1 2 3	1 2 3		1 2 3		1 2 3		1 2 3		1 2 3		1 2 3	2 3	2 3
Stone-carving																							
Blacksmith's Benchwork	2	1 3	1 3	1 2	2	1 3	1 3	2	2	1 3	1 3	1 2	2 3	2 3	1	1 3	2 3	2 3	1 2	1 3	2	1 2	1 3
Machine Benchwork	2	3	3	2	2	3	3	2	2	3	3		2 3	2 3		3	2	2 3	2	3	2	2	3
Copper, Zinc, and Leadwork	1	1 2 3	1 2 3		1	1 2 3	1 2 3		1	1 2 3	1 2 3		2 3	1	1 2		2 3	1	1 2		1 2	2	1 3
Instrument making	2 3				2 3				2 3		2 3			2 3				2 3					
House Painting	1	1 2 3	1 2 3		1	1 2 3	1 2 3		1	2 3	1 2 3		1 2 3	1 2	1 2 3		1 2 3	1 2	1 2 3		1 2	2	2 3

* The three last subjects are taught in the workshops.

NOTE.—Separate classes are conducted for theoretical and drawing subjects and the practical subjects. Those classes split up into subdivisions are indicated by letters and numbers.

Programme

Programme of Lessons at the Ambachts School, Arnhem, 1900–1901.

Days.	Hours.	Practical Instruction. Carpentry.			F.	E.	P.	S.	Ironwork.			S. E.	Drawing. Applied to the different subjects.								Freehand Drawing.			Continuation of Primary Instruction.		
MONDAY.	8–10		II	Ia	I		I	I II	I	Ib	IIa		III I.	Ia I.	I C.	III C.	II & III F.					II & III P.		II I.	IIa C.	
	10–12		II	Ia	I		I	I II	I	Ib	IIa	II		Ia I.			IIa & III C.	II & III F.			I. C.	II & III P.		III I.		
	2–4	IIa & III	I		II & III		II & III		III	Ia	II		.	Ib I.	IIa I.		II C.				I I.		I, I & II P. S.	Ia C.	I F.	
	4–6	IIa & III	I		II & III		II & III		III	Ia	II		IIa I.					I & II F. S.		Ib I.		II C	Ia C.		I I P. S.	I .
TUESDAY.	8–10		II	Ia	I		I	I & II	I	IIa	Ib		III I.			I C.	IIa & III C.	II & III F.	II & III P.		Ia I	II I.				
	10–12		II	Ia	I		I	I & II	I	IIa	Ib	III			II I.		IIa & III C.		II & III P.			II & III F.		Ia I.	I C.	
	2–4	IIa & III	I		II & III		II & III		II	Ia	III	IIa			Ia C.			I, I & II F. S.	I P.		I I.		Ib I.		II C.	
	4–6	IIa & III	I		II & III		II & III		II	Ia	III			I I	Ia C.			I, I & II F. S.				IIa I.	I P.	Ib I.	II C.	
WEDNESDAY.	8–10		II	Ia	I		I	I & II	I	Ib	IIa		II I	Ia I	III I.	I C.			II & III P.			II & III F.		III C.	IIa C.	
	10–12		II	Ia	I		I	I & II	I	Ib	IIa		II I.	Ia I.	III I		IIa & III C.				I C.			III III F. P.	II II F. P.	
	2–4	IIa & III	I		II & III		II & III		III	Ia	II		IIa I.	Ib I.			II C.	I, I & II F. S.	I P.		I I.		Ia C.			
	4 0	IIa & III	I		II & III		II & III		III	Ia	II						II C.	I, I & II F. S.	I P.	Ib I.		IIa I	Ia C.			I I.
THURSDAY	8–10		II	Ia	I		I	I & II	I	IIa	III				II I.	I C.	IIa & III C.	II & III F.	II & III P.		Ia I.			Ib I.		
	10–12		II	Ia	I		I	I & II	I	IIa	III	II					IIa & III C.	II & III F.	II & III P.				Ib I	Ia I	I C.	
	2–4	IIa & III	I		II & III		II & III		II	Ia	Ib	III		I I.	Ia C.							II C.	I F.	II IIa S. I.	I I P. S.	
	4–6	IIa & III	I		II & III		II & III		II	Ia	Ib		IIa I.	I I.	Ia C.		II C.	I, I & II F. S.	I P.			III I				
FRIDAY.	8–10	IIa & III	II		I	II & III F.	I	I & II	I	Ib	IIa		II I.	Ia I	III I	I C.			II & III P.					Ia C.		
	10–12	IIa & III	II		I	II & III P.	I	I & II	I	Ib	IIa		III I.	Ia I				II & III F.				II I		Ia C.	I C.	
	2–4	Ia	I		III		III		II	Ia	III			Ia I.	IIa I.		II C.			Ib I.		IIa & III C.	I F.	II II II F. P. S.	I I P. S.	
	4–6	Ia	I		II & III		II & III		II	Ia	III	IIa					II C.			Ib I.		IIa & III C.	I, I & II P. S.		I F.	I I.
SATURDAY.	8–10	IIa & III	II		II & III		II & III	I & II	III	IIa	II			I I.	Ia C.	I C			I P.		Ia I.		I F.	Ib I.		
	10–12	IIa & III	II		II & III		II & III	I & II	III	IIa	II			I I.	Ia C.				I P.		I C.		Ib I.	Ia I.	I F.	

The Roman figures indicat different classes.

The letters refer to the various trade or subjects of instruction:—

C. Carpentry.
E. Embossing.
F. Furniture-making.
I. Iron or smith's work.
P. Painting.
S. Stone-masonry.
S. E. Instruction in the management of steam engines.

When any of the first six of these letters are placed beneath the number of a class, it shows what pupils are attending that class.

CHAPTER XV.

Industrial and Technical Education in Italy, Japan, Portugal, Norway, and Sweden.

[G. H. KNIBBS.]

1. *Introduction.*—The references to the systems of technical education obtaining in the countries referred to in the title really constitute a continuation to the last chapter. Though Japan was not visited, such information was obtained as seemed to be necessary to understand its system, and it may be said also that the Commissioner writing has for years past regularly read the accounts of the work done in Japan in the higher branches of technological and scientific effort. Japan's educational system, it is well to remember, is eclectic, but is modified by the circumstances of the country. Bearing this latter fact in mind, the trend of Japanese effort becomes most instructive.

ITALY.

2. *Technical Education in Italy.*—In Italy technical education comes under the control of two ministerial authorities,[1] viz.:—

(1) The Ministry of Agriculture, Industry, and Commerce, which is charged with the supervision of commercial, industrial, trade, and industrial-drawing schools, and schools of applied art.

(2) The Ministry of Public Instruction, which is charged with technical schools and institutes.

For example, the former Ministry controls the education in such schools and institutions as the following, viz.:—The Royal Higher Naval School of Genoa, the Royal Industrial Museum of Turin,[2] a number of Royal higher schools of commerce, elementary commercial schools, a large number of industrial schools of "arts and crafts," several higher schools of art-industries, a large number of elementary art-industrial schools and industrial-drawing schools, a number of commercial and industrial schools for women, etc.

The Museum is a State institution, but the other institutions are subsidised by the State, and are supported by local authorities, the province or commune, by chambers of commerce, by workmen's associations, etc.

Examples of the school under both Ministers will be given.

3. *Central Advisory Committee for Technical Education.*—The Ministerial authority varies very much in different cases; and for certain parts of the technical instruction the Minister is advised by a central committee for the teaching of Art as applied to industry.[3]

The functions of the Committee are as follows:—

(1) To keep under review the conduct of art-industrial musems, schools of artistic-industries, schools of drawing for workmen, and similar institutions under the Minister of Agriculture, Industry, and Commerce, which aim at the artistic education of workmen.

(2) To advise as to proposals for creating new art-industrial museums and schools, and the enlargement of existing museums and schools.

(3) To examine the programmes of such schools, with a view to ensuring their response to the exigencies of such artistic and industrial education as specially concerns the locality in which they are situated.

(4) To advise upon the nomination of teachers.

(5) To supervise the pædagogic orientation of art-industry schools, schools for drawing, or the plastic arts.

(6) To provide for the creation and distribution among schools of models in plaster of various typical forms of ornamental Italian Art, and of special collections for the application of art in all branches of industry.

(7) To advise as to publications to be distributed among various schools.

(8) To adjudge as to the merits of candidates for the certificate of the teaching qualification as regards artistic industrial education.

The Royal decree of 29th December, 1895, approved the establishment of regulations to assure adequate qualification on the part of teachers for art-industry drawing schools.

4.

[1] See "Codice della Pubblica Istruzione, ordinato a cura di Giuseppe Saredo." Vol. I-IV. Torino, 1901; and also "Vicende legislative della Pubblica Istruzione in Italia dall'anno 1859 al 1899 raccolte e annotate da Giuseppe Saredo. Torino, 1901."

[2] The "*Regio museo industriale italiano in Torino*" is very finely equipped.

[3] Created by Royal decree 23rd October, 1884, and slightly modified 11th May, 1885.

4. *Reference to Technical Instruction in previous Report.*—The Report of the Commissioners on Secondary Education (6th October, 1904) gave the curricula and details of the course of the technical school (*scuola tecnica*), and the technical institute (*istituto tecnico*) of Italy. [See chap. XXV, secs. 8, 9, pp. 304–5, G. H. Knibbs.] For convenience the programme[1] merely is here repeated. For the development of the subjects reference may be made to the Report.[2]

Programme of the "Scuola tecnica" and the "Istituto tecnico" of Italy.

Subjects.	Technical School.			Technical Institute.			
	Class I.	Class II.	Class III.	Class I.	Class II.	Class III.	Class IV.
Italian ...	6	6	5	6	5	4	6
French ...	3	4	3	3	3	2	...
English or German ...	...	...	...	...	3	5	5
History ...	2	2	2	3	3	2	...
Geography ...	2	2	2	3	3	...	...
Mathematics ...	4	4	3	6	5	5	5
Natural History and }	...	2	2	3	3	...	...
Physics }	...	...	...	...	...	5	3
Writing and Book-keeping ...	...	...	4½	...	...	...	...
Chemistry Lessons ...	...	...	...	...	...	3	...
,, Practice ...	...	...	...	...	...	...	4
Drawing ...	4½	4½	3	6	6	4	6
Caligraphy ...	3	2	2	...	...	...	...
Logic and Ethics ...	...	...	...	...	2	...	...
Civic instruction ...	...	...	1	...	...	...	...
	24½	26½	27½	30	33	30	29

This type of education is under the Minister for Public Instruction. To assure the efficiency of the institutes a "Supervising Council" (*Giunta di vigilanza*) was established.[3]

A complete programme shewing the different types of orientation in the technical school is given in the programme of the next section.

5. *The Technical School of Italy.*—The following is the programme of the "*Scuola tecnica*":—

Programmes of various Types of Technical School ("Scuola tecnica") in Italy.

Subjects.	Schools.												Schools and Sections for Women.					
	Ordinary type. (*Scuole di tipo commune.*)			With Agricultural orientation. (*Scuole con indirizzo agrario.*)			With Commercial orientation. (*Scuole con indirizzo commerciale.*)			With Industrial orientation. (*Scuole con indirizzo industriale.*)			Ordinary type.			With commercial orientation.		
	Years.			Years.			Years.			Years.			Years.			Years.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
Italian ...	6	6	5	6	5	5	6	5	5	6	4	4	6	5	5	6	5	5
Rights and duties of citizens.	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Geography ...	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
French ...	3	4	3	3	4	3	3	3	4	3	3	2	3	4	3	3	3	4
Mathematics ...	4	4	3	4	4	3	4	2	2	4	4	3	3	3	3	3	2	2
Natural Sciences ...	...	...	2	...	3	3	...	3	3	...	3	3	...	2	2	...	3	3
Accountancy ...	...	...	4½	...	...	3	...	3	5	...	...	3	...	2	3	...	3	4
Drawing ...	4½	4½	3	4½	4½	3	4½	1½	...	4½	4½	5	4½	3	3	4½	1½	...
Caligraphy ...	3	2	2	3	2	2	3	2	2	3	2	...	2	2	2	2	2	1
Agriculture ...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...
German or English ...	...	...	...	...	...	...	...	4	4	...	...	...	...	...	...	...	3	4
Elementary Mechanics	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Industrial Technology	...	2	...	...	...	...	...	...	...	...	2	3	...	...	...	...	...	...
Feminine work ...	...	—	...	...	...	...	...	...	...	...	...	...	2	2	...	2	...	2
Totals ...	24½	26½	27½	24½	26½	29	24½	27½	29	24½	28½	29	24½	27	27	24½	26½	29

To

[1] For a complete account of the courses, reference may be made to the *Codice pubblica istruzione*, Vol. II, pp. 86–155, and also pp. 156–224. See "Programmi per gli esami di ammissione alla I classe delle Scuole tecniche," ed "Istruzioni e programmi d'insegnamento." See also "Istituti tecnici e nautici."

[2] See p. 305. The punctuation on the page is omitted. Thus "French School" should read *French.* (School) . . . . (Institute), and similarly throughout.

[3] Established by Royal decree, 15th June, 1865. For the regulations governing the "*Giunta di vigilanza,*" see R. decreto 21 giugno, 1885, n. 3,413, che approva il regolamento generale per gli istituti tecnici. Capo II. loc. cit. pp 163–167. "In ogni citta ove ha sede un *istituto tecnico, o altra scuola d'istruzione industriale e professionale,* vi ha una Giunta di vigilanza."

To become a *regular* pupil of one of these schools it is necessary to pass the examination (*esame di ammissione*) by which a certificate (*certificato di licenza*) is obtained. If this be not done in the higher primary school, an examination is held on Italian, arithmetic, the metric system, caligraphy. This examination is partly oral and partly written. Not more than fifty pupils may be in one class. Where that number is surpassed two classes are formed.

Although every detail as to the order and time of instruction is fixed by Royal decree, this is not rigorously followed, and considerable latitude is exercised.

Passing from one class to another is by examination (*esame di promozione*), and on passing the final examination (*esame di licenza*) the pupil receives an attestation (*certificato di licenza*), showing the marks obtained throughout.

Passing the third class of the technical school admits to the first class of the technical institute, and also to the first class of the normal schools.

The technical schools, about 300 in number, are practically gratuitous, 5 lire being charged for admission, 10 for registration, and 15 for the certificate (say, 4s., 8s., and 12s.).

6. *The Technical Institute of Italy.*—Originally the "*Istituto tecnico*" had four sections, viz.:—

(1) A commercial and administrative section;
(2) An agronomic section;
(3) A chemical section; and
(4) A physico-mathematical section.

But the right was conceded of adding such practice schools or improvement courses as might be regarded as best responding to special local needs.

The decree of 13th October, 1865, gave to the institutes an organisation differing somewhat from the first, and the number of sections was increased to nine, viz.:—

(1) Agronomy and surveying.
(2) Commerce and administration.
(3) Mechanics and construction.
(4) Chemical industries.
(5) Mechanical industries.
(6) Physico–chemical industries and mechanics of precision.
(7) Marine trade.
(8) Mineralogy and metallurgy.
(9) Accountancy.

The duration of the courses was extended from three to four years.

Experience with this reorganisation later led the Italian authorities to recognise that education of a certain type would not necessarily *create* an industry, which was in a measure attempted by the above programme, and it was more clearly recognised that the theoretical and practical studies must to a very large extent be so orientated as to meet the existing needs of local industries and callings. The agronomy section, the commercial and administrative section, to which accountancy was added, the mechanical construction section, progressed considerably, and an important reorganisation was made in 1871, consequent upon the study and analysis by competent commissions, of the whole bearing of the question.

The effect of the analysis was that the technical institutes commenced to be regarded as schools of special culture, where modern languages could be studied, and where a theoretical and practical preparation for the higher studies of physics and mathematics, and indeed also of certain professional careers, such, for example, as accountants, computers, surveyors, could be obtained.

Reforms were made in 1871, 1876, and 1877 by the Minister of Agriculture, Industry, and Commerce, and in the following year, 1878, the care of technical institutes returned from his jurisdiction back to that of the Minister of Public Instruction, who had been relieved of it in November, 1861.

In 1883 a Commission was nominated by the Minister, Guido Baccelli, whose work led to the regulation of 1885, and decree of 2nd October, 1891, provisions which determine the present constitution of the so-called technical institutes.

This very inadequate reference to the history of technical education will serve to shew that the question of organisation is not a simple one in the Italian view, and that it has been very fully discussed.[1]

At the present time the *istituto tecnico* has three sections, viz., the physico-mathematical (*Sezione fisico-mathematica*), the surveying section (*Sezione di agrimensura*), and the commercial and accountancy section (*Sezione di commercio e ragioneria*).

The programmes of these are given hereunder, and are compiled from the horary tables given in sources of official information, that is, the Royal decree of 2nd October, 1891, which is in force.[2]

Programmes

---

[1] The organisation of education is really a difficult problem, as a study of the educational development of any country of Europe will shew. It is only where there is no real organisation that the authorities regard the matter as simple, and treat it as one which can be lightly despatched.

[2] Regio decreto 2 ottobre, 1891, n. 622, che approva i programmi d'insegnamento per gli istituti tecnici del Regno. See Codice Pubbl. istruz. vol. II pp. 224–293, specially pp. 290–292. Logic and Ethics were originally included, but were abolished by decree of 16th August, 1892.

Programmes of the branches of the Technical Institute, Italy.

Subjects.	Years, and Hours per Week.									
	Common.	Physico-mathematical.			Surveying.			Commercial.		
	I.	II.	III.	IV.	II.	III.	IV.	II.	III.	IV.
Chemistry Lectures	...	...	3	...	...	3	...	...	3	...
„ Practice	...	...	...	4	...	...	4	...	...	...
Ornamental Drawing	6	6	...	...	4	...	...	...	...	...
Architectural Drawing	...	...	4	6(3)	...	...	...	...	...	...
General Physics	...	...	5	...	...	5	5	...	5	...
Supplementary Physics	...	...	...	3	...	...	...	...	...	...
Geography	3	3	...	...	3	...	...	3	...	...
Italian Literature	6	5	4	6	5	4	6	5	4	6
French Language	3	3	2	...	3	...	...	3	2	2
English or German	...	3	5	5	...	...	...	3	5	5
Logic and Ethics (abolished)	...	...	...	...	...	...	...	...	...	...
Mathematics	6	5	5	5	5	...	...	5	...	...
General History	3	3	2	...	3	2	...	3	2	...
Zoology and Botany	3	...	...	...	...	...	...	...	...	...
Mineralogy and Geology	...	3	...	...	3	...	...	3	...	...
Agriculture	...	...	...	...	...	2	3	...	...	...
Agricultural Accountancy	...	...	...	...	...	2	...	...	...	...
Construction	...	...	...	...	...	2	2	...	...	...
Constructional drawing	...	...	...	...	2	3	3	...	...	...
Estimates of Value	..	...	...	...	...	...	4	...	...	...
Rural legislation...	...	...	...	...	...	..	2	...	...	...
Typography	...	...	...	...	...	3	9(5)	...	...	...
Topographical Drawing	...	...	...	...	3	3		...	...	...
Descriptive Geometry	...	...	..	...	...	3	...	...	...	...
Caligraphy	...	...	...	...	...	...	...	2	1	2
Book-keeping and Accountancy ...	...	...	...	...	...	...	...	4	5	9
Civil law	...	...	...	...	...	...	...	...	3	...
Commercial and administrative law ...	...	...	...	...	...	...	...	...	...	4
Political economy	...	...	...	...	...	...	...	...	3	...
Financial Science and Statistics ...	...	...	...	...	...	...	...	...	...	4
Total... ...	30	31	30	29	31	32	33 ?	31	33	32

The above table shews at a glance how far there is any agreement and difference between the courses. Italian, for example, is the same throughout.

7. *Nautical Technical Institutes, Italy.*—The "*Istituti tecnici nautici*" have one or more of the courses above indicated, together with one or more naval courses; for example, for captains of the mercantile navy (*Sezione dei capitani marittimi*), for naval architects (*Sezione dei costruttori navali*), formarine engineers (*Sezione dei macchinisti navali*). Or again they may be exclusively nautical schools, *e.g*, Piano di Sorrento, Camogli. These institutes received their present organisation in January, 1891.[1]

There is a *preparatory course* of two years, including Italian, descriptive geography, caligraphy, arithmetic, algebra, geometry, linear drawing[2]; then there are three distinct courses, as above indicated.[3]

These courses are well advanced. The following programme gives the whole of the three courses:—

Programmes of the "Istituto tecnico nautico," Italy.

Subjects.	Courses, and Hours per Week.								
	Captains of Mercantile Navy.			Naval Construction.			Marine Engineers.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.
Italian language and literature	6	4½	4½	6	4½	4½	6	4½	4½
French or (and) English	3	3	2	(3	3	2)	3	3	2
Algebra	4½	...	...	4½	...	...	4½	...	...
Geometry	4½	...	...	4½	...	...	4½	...	...
Trigonometry, Plane (and Spherical)	(4½)	...	...	4½	...	...	4½	...	...
Experimental Physics, Elementary Mechanics ...	6	...	...	6	...	...	6	...	...
Supplementary course in Physics...	...	...	...	...	...	...	...	4½	...
Applied Mechanics...	...	...	...	...	3	...	...	3	...
Steam Engines	...	3	...	...	3	...	...	9	4½
Duty of Engine, Fuel, Material, etc.	...	...	...	...	...	...	...	3	...
Rigging and manœuvres	6	4½	...	...	...	...	...	...	...
Drawing Steam Engines, etc.	...	...	...	...	...	...	...	6	6
Naval Construction and Materials	...	...	...	3	4½	4½	...	...	...
Drawing—Naval Architecture	...	...	...	6	8	8	...	...	...
Navigation	...	4½	3	...	...	...	...	...	...
Geographical and Nautical Astronomy	...	3	4½	...	...	...	...	...	...
Meteorology	...	...	3	...	...	...	...	...	...
Commercial Geography	...	3	2	...	...	...	...	...	...
Law	...	4½	...	...	2	...	...	...	...
Accountancy (ships)	...	...	3	...	...	...	...	...	...
Descriptive Geometry	...	..	...	3	3	...	3	...	...
Theory of Vessels	...	...	...	...	4½	4½	...	...	...
Practical Exercises	...	...	...	...	...	...	...	...	...

Some sections are for half a year ("*Semestre*") only.

8.

[1] Regio decreto, 1 gennaio, 1891, n. 13.
[2] Corso preparatio. Cod. Pubbl. Istruz. Vol. II, p. 301.
[3] *Ibid*, pp. 302–304.

8. *The Technical Institute Germano-Sommeiller, Turin.*—The oldest technical institute of Italy is the *Istituto tecnico "Germano-Sommeiller" di Torino*, founded in 1858. In addition to the physico-mathematical, surveying, and commercial sections, it possesses also an industrial section representing mechanical industries and weaving. The textile industry, predominant in the suburbs of Turin, explains the orientation of the work of the Institute. This establishment possesses large physical and chemical laboratories, mechanical workshops, workshops for spinning and weaving, numerous machines of the best class. A gas engine supplies the power required. The instruction is theoretical and practical, and is completed by visits to factories in the neighbourhood.

The number of regular day-pupils in this Institute is something like 500. It has also evening and Sunday courses, a school of commercial technique and practice with over 100 pupils, a theoretical and practical course for a few army and naval officials, and *evening courses* for workmen, with nearly 500 pupils. Altogether it has therefore nearly 1,100 pupils.

The two first years are common for all pupils in the regular day-courses, and the special courses are in the third and fourth year. The programme is as follows:—

The programme of the "Istituto Tecnico Germano-Sommeiller di Torino, Italia."

Subjects.	Years, and Hours per Week.			
	Common Courses.		Special Courses.	
	I.	II.	III.	IV.
Chemistry, General, Elementary, Organic ...	...	...	4	...
Tinctorial Chemistry	...	...	...	2
Laboratory Practice	...	...	...	2
Mechanical Drawing	...	...	6	6
Ornament Drawing, Geometrical...	4	3	...	...
" " Sketches	4	3	...	...
Elementary Physics	...	3	3	...
Applied Physics and Laboratory Practice ...	...	...	...	2+2
Geography	3	3	...	...
Italian Literature	6	6	4	...
French Language	3	3	...	...
Elementary Algebra and Geometry	6	6	...	...
Trigonometry, with Algebra and Geometry ...	...	...	2	...
Descriptive Geometry, Theoretical	...	...	2	...
Practical Descriptive Geometry	...	...	2	...
Industrial Mechanics	...	...	3	3
Practical Exercises...	...	...	2	2
Study of Merchandise and Practical Work ...	...	...	...	3+2
General History	3	3	2	...
Botany (Zoology)	2	(2)	—	...
Geology and Mineralogy	...	...	3	...
Mechanical Technology	...	...	...	3
Textile Technology...	...	...	2	2
Workshop Practice	...	...	...	4
Total	31	32	35	33

The fees are—for immatriculation, 20 lire, inscription or registration, 66 lire, per annum; license, 78 lire; diploma, 10 lire. The lira may be taken as the same value as the franc.

9. *Royal Industrial School at Naples.*—Though recent, this is one of the most important schools of Italy, and was established by the Naples Municipality, and reorganised by Royal Decree in January, 1886. It is intended to provide such education as shall develope skilful workmen and overseers of factories, and of mechanical and chemical industries. It has four sections, viz., one for mechanics, for working electricians, for founders, and one for working chemists.

The equipment of the school allows about 120 pupils to work in the mechanical workshop, which has a 12 h.p. steam-engine as a source of power. The foundry has a 4 h.p. motor. The electro-technical laboratory has a gas-engine of 3 h.p.; and is provided with two dynamos and all the apparatus, etc., for electro-plating.

In the fourth year the pupils, of which there are about 350, are engaged entirely in practical work.

The

The following programme shews the work in each section :—

Programme of the Royal Industrial School (Scuola industriale) of Naples, Italy.

Subjects.	Courses, and Hours per Week.													
	Preparatory Course.	Course I (common).	Mechanical Section.			Foundry Section.			Electrical Section.			Chemical Section.		
			II.	III.	IV.	II.	III.	IV.	II.	III.	IV.	II.	III.	IV.
Italian History, Geography...	6	4½	...	...	...	...	...	...	...	...	...	...	...	...
French	4½	4½	...	...	...	...	...	...	...	...	...	...	...	...
Arithmetic	6	4½	...	...	...	...	...	...	...	...	...	...	...	...
Geometry	4½	4½	...	...	...	...	...	...	...	...	...	...	...	...
Algebra and Trigonometry...	...	...	3	...	...	3	...	...	3	...	...	3	...	...
Geometrical Drawing ...	4½	4½	...	...	...	...	...	...	...	...	...	...	...	...
Ornamental Drawing ...	...	4½	...	...	...	...	...	...	...	...	...	4½	...	...
Writing	3	3	...	...	...	...	...	...	...	...	...	...	...	...
Accountancy...	...	...	3	3	...	3	3	...	3	3	...	3	3	...
Modelling	...	...	6	...	...	6	6	...	6	6	...	...	...	...
General Physics	...	...	4½	4½	...	4½	4½	...	4½	4½	...	4½	4½	...
Applied Physics	...	...	...	...	4½	...	...	4½	...	...	4½	...	...	3
General Chemistry	...	4½	4½	...	...	4½	...	...	4½	...	...	4½	4½	...
Applied Chemistry	...	...	...	...	...	...	4½	4½	...	...	...	...	...	4½
Mechanics	...	...	...	4½	...	...	4½	...	...	4½	...	...	...	...
Applied Mechanics	...	...	...	...	4½	...	...	4½	...	...	4½	...	...	...
Mechanical Technology ...	...	...	3	3	...	3	3	...	3	3	...	...	...	...
Mechanical and Industrial Drawing	...	...	6	6	6	6	6	6	6	6	6	...	...	...
Workshop Practice	...	6	12	21	27	12	21	27	12	21	27	12	30	35
	28½	40½	42	42	42	42	52½	46½	42	48	42	31½	42	40½

This institution is subsidised by the State to the extent of 21,000 lire per annum and the province and commune 6,000 and 27,000 lire respectively—roughly, about £2,160. Pupils pay 10 lire (say 8s.) for the first year and 5 lire (say 4s.) for each subsequent year.

10. *School of Arts and Crafts, Genoa.*—The arts and crafts school of Genoa was founded in 1892 by the Municipal Council. Pupils are received at 15 years of age. The instruction, both theoretical and practical, lasts six years, covering two periods, only the better-endowed pupils continuing during the second period.

The practical instruction covers the following, viz. :—

(1) Wood-working, Joinery, and Cabinet-making, Carving.
(2) Typography—Composing, Printing.
(3) Lithography—Engraving, Printing, etc.
(4) Mechanical Work.
(5) Electrical Work.
(6) Artistic Iron Working.

The whole of the teaching is gratuitous, and the pupils number about 150.

11. *Technical Schools of San Carlo, Turin.*—The technical schools of San Carlo, Turin, afford another illustration of the provision made in Italy for technical education. These schools are the outcome of the energy of an association, the "*Società delle scuole tecniche operaie di San Carlo.*"[1] They are part of the response made to a recognition of the fact that "the cardinal problem for the fortune of Italy is essentially the problem of its education."[2]

The instructional courses are the following, viz. :—

General Instruction—

Italian literature, Classes I, II ; Arithmetic, I, II ; Caligraphy ; Public accountancy ; Physics ; Chemistry ; Principles of economics ; Economics of industry ; Estimation of value and professional economics ; Public hygiene.

Artistic-Industrial

[1] An account is given by G. G. Serra, entitled "*Le Scuole tecniche operaie, San Carlo in Torino, memorie raccolte da G. G. Serra.*" 1848–1898. Torino, 1898.

[2] Discorso dell' Avv. Enrico Gariboldo, rendiconto del 1901-2. Soc. Scuole tec op. Torino, 1902. "Il problema cardinale per la fortuna d'Italia è essenzialmente un problema d'educazione."

Artistic-Industrial Instruction—

Elementary Courses.—Geometry and geometrical drawing, two years; Ornamental drawing, three years.

Higher Courses, 1st Section.—Ornamentation. Normal course of ornamental drawing, three years; course of ornamental plastics, four years. *Special Courses.*—School of the elements of the human form, four years; school for drawing flower ornamentation; school of heraldic drawing; history of art and of industry.

Higher Courses, 2nd Section.—Normal course of Architecture (*Corso normale d'arte muraria*).—Practical geometry. Architectonic drawing, three years; construction. *Special Courses.*—Drawing applied to the art of cabinet-making; school of iron industries, three years; school for stoking, etc. (*scuola per gli operai fumisti*).

Higher Courses, 3rd Section.—Mechanics and mechanical drawing, mechanics; school of mechanical drawing, three years. *Special Courses.*—Course in the Steam-engine for workmen in charge of boilers and steam-engines; electro-technics.

The Art industrial-work seen by the Commissioners at the San Carlo school.

12. *Technical Schools for Young Women, Rome.*—The "*R. Scuola tecnica femminile 'Marianna Dionigi,' in Roma,*" was created in 1883 to afford an education somewhat technically orientated and suitable for young women. The programme is as follows:—

Programme of the "R. Scuola tecnica femminile 'Marianna Dionigi,'" Rome.

Subjects.	Years, and Hours per Week.		
	I.	II.	III.
Italian ...	6	5	5
French ...	3	4	3
History of Italy—Rights and duties of citizens and of women in particular.	2	2	2
Geography ...	2	2	2
Arithmetic and Elements of Geometry ...	3	3	3
Natural Sciences ...	...	2	2
Accountancy ...	...	2	3
Drawing ...	4½	3	3
Caligraphy ...	2	2	3
Needlework ...	2	2	2
Gymnastics and other physical exercises ...	2	2	2
Totals ...	26½	29	29

The professional school for girls, "*Margherita di Savoia,*" was founded in 1876, and has an industrial and also a commercial section. The industrial section embraces a number of occupations, the courses for which are various in duration, as see the following list:—

(1) Lingerie, embroidery (white), machine embroidery, lacework, 3 years.

(2) Ornamental drawing, 3 years.

(3) Geometrical drawing, 1 year.

(4) Course in confections and manufacture of artificial flowers is 4 years, and embraces the two preceding courses (2 and 3).

(5) Embroidery in silk and in gold, 5 years; drawing for 4 years.

(6) Ironing, repairing, cooking, etc., etc., 2 years, without drawing.

(7) Dressmaking, 3 years, without drawing.

The fee is 3 lire (say, about 2s. 6d.) per month.

13. *General Remarks on Italian Technical Education.*—The above account of Italian technical education is quite inadequate to give a correct idea of what is being done. From what the Commissioners saw of equipments, and of evidences of recent progress, it is quite clear that Italy, no less than other countries, is alive to the importance of technical education.

In concluding this reference thereto, the opportunity is taken of referring to the question of logic and ethics in the technical courses. As stated in the previous foot-note, a short course in *Logic and Ethics*, involving two hours a week for one year, has been abandoned. The wisdom of such abandonment may be called in question, unless such a course in philosophical propædeutics as has become common throughout the whole range of secondary education be substituted therefor.

With

With a view of disclosing the nature of the course the following translation is made by the Commissioner here writing from the Italian programme. This course in question was common to all the divisions of the "Istituto tecnico."

Elements of Logic—
(1) Analysis of thought. Sensation and perception. Conception, judgment. Definition, division, and classification of concepts.
(2) Ratiocination and its species. Deduction, induction, and analogy.
(3) Of cognition, and truth; fundamental principles of knowledge. Truths of reason, and of fact; criteria of truth.
(4) State of the mind in respect of truth; certitude, doubt, opinion. Error and its various species; sophistry.
(5) Method and its various species; rational method, analysis and synthesis, axioms, and theorems.
(6) Experimental method, observation, experiment; hypothesis and natural laws. The explanation of fact. Quantitative determinations among phænomena. Hints upon the statistical method.
(7) The demonstrative method and demonstration.

Elements of Ethics—
(1) Hints as to the nature of feeling and will; liberty and moral actions.
(2) Natural tendency of man to seek pleasure and happiness. The idea and feeling of duty. The supreme end of the moral law.
(3) Character. The unfolding and sanction of the moral law. Hints on the fundamental ethical doctrines.
(4) Moral conscience and responsibility.
(5) Particular duties—duty of right conduct and of self-improvement; on the formation of character.
(6) Human society; duties and rights; distinction and relation between the moral law and juridical laws.
(7) The family; its moral and juridical relationships.
(8) Man and civilised society. The conception of the State and of its principal forms; powers of the State; their relations and limits; rights and duties of citizenship.

Whatever may be thought as to the limitations and imperfections of the courses above outlined—and in this connection it is well to remember that much depends upon the lecturers on the subjects—such courses would probably go far to deliver the students who later are called upon to take a more responsible part in the affairs of citizenship from those logical errors and ethical crudities, the commonness of which is the despair of almost every sane man. It is open to question whether the abandonment of such a course as the above is not really *a retrograde step.* Probably certain controversial elements in the course were regarded as politically dangerous, and the possibility of such questions as are indicated in Logic (4), and Ethics (3), being treated in a certain way, may go far to explain the abandonment of the courses.

It may be said that there is a clear recognition that the connection of the sciences, and of the fundamental conceptions under which all forms of knowledge are, or ought to be, subsumed, is of great and increasing importance. A short course in logic accentuates the keenness of analytic penetration of mind, and in this way enhances human power.

Japan.

14. *Technical and Industrial Education in Japan.*—"Professional," industrial, and commercial education in Japan were regulated by the law No. 21 of 1894, and by an imperial rescript No. 29 of 1899. The ordinary subsidy to "professional" schools is 250,000 yèn (roughly, £51,000). The Minister indicates among public schools of civil engineering, commerce, or among apprentice schools, or continuation professional schools, those which deserve subsidy, and professional schools established by agricultural, industrial, or commercial authorities, participate in the subsidy.

The lower class of technical schools are the *supplementary professional schools*, and the *apprentice schools.* The former aim at affording both general and practical knowledge in the calling selected.

Students who enter the supplementary professional schools should have attained an educational status equal to that demanded for the final examination in the ordinary primary school. Nevertheless, children who have passed beyond the school-age may be admitted to the courses.

The general part of the course embraces ethics, reading, writing, arithmetic, and practical knowledge. This last is determined by local circumstances, and may, for example, include such subjects as drawing, modelling, geometry, physics, chemistry, natural science, industrial projects, manual work, etc.

In the commercial localities, commercial correspondence and arithmetic, articles of commerce, commercial geography, accountancy, commercial laws and customs, commercial political economy, and foreign languages, are the subjects embraced.

Similarly other subjects, indicated by local conditions may be and are introduced, such, for example, as marine products, weaving, embroidery, etc., etc.

Pupils may select a single one, or several practical studies, and the duration of the course is three years or more.

The *apprentice schools* are governed by regulation No. 20 of 1899, and are for children of 12 years of age and upwards, but in exceptional cases even younger children may be admitted, provided they have passed through the ordinary primary course.

The *industrial technical schools* are under Ministerial Ordinance No. 8 of 1899, the period of study being normally three years, which may be prolonged to four. A preparatory course may also be established.

The number of schools of various types is as follows:—

Type of School.	No.	Teachers.	Pupils.
Industrial schools	21	240	1,993
Apprentice schools	25	147	1,528
Supplementary schools for technical instruction	221	431	12,992
Agricultural	79	583	7,778
Commercial	41	546	9,842
Nautical	5	39	533

15. *School of Industry, Tōkyō.*—As an example of the development of an industrial school, the Tokyo School of Industry may be selected. It has six courses, two being, however, subdivided. The following table will disclose the whole :—

Courses—School of Industry, Tōkyō.

Course.	Theoretical Instruction.	Practical Instruction and Experimental Work.
1 (*a*). Dyeing...	Dyeing, weaving. Drawing. Preparation of fibre, tissues, etc.	Elements of weaving. Purification, bleaching, dyeing, printing cotton, wool, silk. Preparation of indigo. Various dyeing experiments.
1 (*b*). Weaving	Applied dynamics. Weaving. Drawing. Preparation of fibres, tissues, etc. Spinning.	Elements of dyeing. Weaving. Analysis of stuff goods. New process of weaving. Jacquard loom. Drawing for a Jacquard weaver. Weaving machines. Twisted thread.
2. Ceramic Art	Mineralogy. Applied geology. Ceramics.	Faïence. Porcelain. Glassmaking, cement, bricks, etc.
3. Applied Chemistry.	Mineralogy. Machines, Metallurgy. Special applied chemistry. Electro-chemistry.	Manufacture of therapeutical agents, of colours. Fermentation. Sugar refining. Refining of petroleum. Tanning, etc.
4. Mechanics ...	Manufacture of machinery. Iron and steel, applied dynamics. Industrial electricity. Manufacturing machinery motors.	Steam, gas, petroleum, and hydraulic engines. Spinning and weaving machines.
5 (*a*). Electro-mechanics.	Electro - magnetism. Manufacture of machinery. Applied dynamics. Industrial electricity. Motors.	Distribution of electric energy. Electric railways. Electric light, etc.
5 (*b*). Electro-chemistry.	Mineralogy. Electro-magnetism. Industrial electricity. Metallurgy. Special applied chemistry. Electro-chemistry.	Electric furnaces. Electro - plating and galvano-plastics. Electro-metallurgy.
6. Industrial projects.	Rules for industrial drawing and plans. History of the industrial arts. Applied anatomy.	Drawing of articles in wood, metal. Lacquer work. Ceramics, dyeing, weaving, etc.

The above school is for pupils of 17 to 25 years of age, the fee being 15 yèn per annum (say, roughly, £3).

Pupils of special merit may proceed to higher courses.

It may be mentioned that Japan's expenditure for education for 1901–2 was about £8,700,000, and the new buildings of the Higher School of Commerce cost about £73,500.

For a fuller account of Japanese technical education reference may be made to Chap. XXXI, pp. 363–368, of the "Report of the Commissioners, mainly on Secondary Education." This chapter referred to is entitled "Recent Educational Advance in Japan."

Portugal.

16. *Technical Education in Portugal.*—The modern system of education in Portugal originated with Sebastian Joseph de Carvalho e Mello, Marquez de Pombal, in 1762, but there was no real attempt to organise technical education until the decree of 13th December, 1832. Twelve years later there was an important reform which went far to give the education of to-day its present constitution. This, however, did not materially affect the scheme of industrial education, which remained practically what it was in 1832. In 1864, however, it was reorganised, so as to be divided into two degrees only, viz. :—

(1) *General Education*, common to all the industrial arts and callings.

(2) *Special Education* for the various industrial arts and for factories, etc.

Each of these was again divided into a theoretical and practical part. The former was given in industrial schools, known as "*industrial institutes*" at Lisbon and Oporto; and in the country in somewhat similar establishments, known as "*industrial schools.*"

The practical part of the education was given in factories, State establishments, workshops, and special manufactories, agreeably to an arrangement between the Government and the chiefs of such institutions. The instruction of type (1) above, comprised manual exercises and the following, viz. :—

(*a*) Arithmetic, algebra, elementary geography, linear drawing.

(*b*) Principles of physics and chemistry, and the general ideas of mechanics.

(*c*) Elementary technology and geometrical drawing.

A higher degree of instruction, given in the institutes, consisted of a large number of courses, viz.:—

(*a*) Arithmetic, algebra, geometry, trigonometry, and linear drawing.
(*b*) Descriptive geometry applied to industry, topography and topographical drawing, drawing of mechanical models.
(*c*) Physics and its applications to the arts, to telegraphy, and to lighthouses.
(*d*) Chemistry, as applied to the arts, dyeing, etc.
(*e*) Industrial mechanics, as applied to machinery, steam-engines, and applied mechanics in relation to construction generally.
(*f*) Civil engineering, technology.
(*g*) Mining exploitation, geology, metallurgy.
(*h*) Ornamental and architectural drawing.
(*i*) Accountancy, the principles of industrial economy, statistics, commercial and administrative law.
(*j*) French and English languages.

The above subjects were supposed to met the requirements of directors of factories, overseers of industrial works, contractors, mining managers, mechanics, stokers, etc., telegraphists, carpenters, architects, persons in charge of lighthouses, overseers in chemical and dyeing industries, manufacturers of instruments of precision.

The mode in which the details of this instruction were developed was modified in 1864, 1869, 1880, and 1884, and the present scheme was established by the regulations of the 30th June, 1898.

The instruction at the present time in *commerce* embraces a higher and a secondary course, and that in *industry* embraces courses in the chemical arts, in electro-chemistry, mechanics, civil engineering, mining, telegraphy, and a higher industrial course.

17. *Technical Institute of Portugal.*—The theoretical part of the education in the Technical Institute is given in twenty-three courses, any of which may be taken at the option of the pupils. In the commercial, industrial, electro-chemical, mechanical, civil engineering, mining, telegraphic, and higher industrial *divisions*, having courses ranging between three and six years, there is a definite prescription as to which and how much of each of these twenty-three courses must be taken. In each *division* there is both theoretical and practical instruction, the former being six hours a week for each course. The practical instruction, varying with the subject, is given (a) in the commercial bureau, or in the student halls, cabinets, laboratories, museums, or workshops in the Institute; (b) in the State factories and in industrial establishments; (c) by field work, visits to State works, either completed or in progress, at the taxation bureau, and customs offices, and other public and private establishments.

The pupils are *regular* or *irregular*, the former taking every prescribed course, the latter taking the courses at pleasure. To be qualified for admission, both are required to have qualified for admission to the National lyceums, or else to have successfully passed an examination in any official school whatsoever, in Portuguese, French, geography, history, arithmetic, plane geometry, the principles of physics and chemistry, elementary natural history, and geometrical drawing.

18. *Industrial and Technical Schools, Portugal.*—The instruction in industrial schools is divided into three courses, viz.:—

(a) Industrial drawing; (b) "Professional" courses; (c) Industrial courses.

(a) Includes general and special drawing; (b) embraces both manual training and the corresponding theoretical instruction; and (c) embraces improvement courses for workmen and apprentices of all kinds.

The following synopsis indicates the complete organisation:—

Industrial Drawing—General: Class I, elementary drawing, years 1 and 2. Special: Class II, architectural, mechanical, and decorative drawing, years 1, 2, and 3.

"Professional"—Class I, II, industrial drawing. Class III, Portuguese. Class IV, arithmetic and geometry. Class V, elements of physics and chemistry, manual work. Year 1, elementary drawing, Portuguese, arithmetic and geometry. Year 2, the same, and manual work. Year 3, architectural or mechanical or decorative drawing, elements of physics and chemistry, manual work. Year 4, the same. Year 5, the same.

Industrial—Class IV, arithmetic and geometry. Class V, geography and history of Portugal, general geography. Class VI, French. Class VII, elements of physics and chemistry, elements of natural history. Class VIII, industrial physics and mechanics, industrial chemistry. Year 1, elementary drawing, Portuguese, arithmetic and geometry. Year 2, same subjects. Year 3, industrial drawing, architectural or mechanical or decorative drawing, Portuguese, geography and history, elements of physics, chemistry and natural history. Year 4, industrial drawing as in Year 3. General geography, French, industrial physics and mechanics or industrial chemistry. Year 5, industrial drawing as before, industrial physics and mechanics or industrial chemistry.

The professional (trade) courses include instruction in decorative painting, weaving, metal engraving, ornamental leather work, locksmithing, chasing, etc.; moulding, stucco-figure making, wood-carving, bookbinding, pottery, faïence, ship-carpentry, masonry, cabinet-making, ordinary carpentry, smithing and iron-working generally, various types of mechanical work, foundry work, cutlery, tanning, dyeing, etc.

For women, the courses include instruction in embroidery, lace-making, cutting-out and making-up, dressmaking, manufacture of artificial flowers, etc.

This brief account is sufficient to indicate that the Portuguese recognise the principle that industrial efficiency demands a carefully-developed system of technical training, and their effort has been carefully directed, and is being intensified.

Norway

Norway.

19. *Lower Technical Education in Norway.*—At the time of the Commissioners' visit to Norway, there were about nine subsidised schools for the industrial education of young women—five being municipal and four private. The courses include sewing, dressmaking, art-needlework, weaving and tailoring. The courses in weaving, basket-making, wood-carving, etc., are provided both for adults and for children by associations in the rural districts.

The elementary technical schools of Norway (Haandvaerksskole, etc.), of which there are about fourteen, are evening schools. Pupils must be at least 14 years of age, able to read and write, and possess a knowledge of arithmetic as far as the four fundamental operations with whole numbers and fractions. The courses are usually three years, and extending over about eight months in the year; two hours each evening for five days a week being the duration of the instruction.

20. *Art Industrial Education, Norway.*—The art-industrial type of school is represented by such a school as the Royal Norwegian Art and Industrial School (*Kgl. norske Kunst- og Haandvaerksskole i Kristiania*).

It has (a) five courses in freehand drawing (*frihaandstegning*), one of which is drawing from the living model: (b) four courses in geometrical and constructional drawing (*konstruktionstegning*), including projection, perspective, descriptive geometry, mechanical drawing; (c) three courses in ornamental drawing (*ornamenttegning*); (d) three courses of modelling (*modellering*) in clay and wax, from casts, etc., the living model, composition; (e) two courses in architectural drawing (*bygningstegning*) including architectonic theory; (f) two courses of professional drawing for handworkers (*fagtegning for haandvaerkere*); (g) a course of decorative painting (*dekorativt maleri*); (h) a course in art engraving, etching, lithographing, etc. (*grafisk kunst*); and (i) a course in arithmetic and geometry (*arithmetik og geometri*). There are day and evening classes (*dag og aftenskolen*) in the school.

21. *Mechanics' School, Porsgrund.*—The "*Skiensfjordens mekaniske fagskole*," of Porsgrund, was originally subsidised by the State, and became a State school from 1st April, 1901. It is a two-year school, with a common section for the first year and a mechanical and electro-technical section for the second. It may here be noted that both Norway and Sweden recognise that the large sources of energy they possess in their streams may be utilised through electro-technics. The programme of the school is as follows:—

Programme of the "Skiensfjordens Mekaniske Fagskole" at Porsgrund.

Subjects.	Years, and Hours per Week.		
	I.	II.	
		Mechanical.	Electrical.
Arithmetic and Algebra ... ... / Geometry, Planimetry, and Stereometry ... ... / Practical Calculations	5	......	......
Mechanics	3	3	2
Mechanical Technology	2	......	......
Freehand and Geometrical Drawing	10	......	......
Workshop	6	6	......
Smithy and Metal Working	6	6	......
Machine Shop	12	12	......
Trigonometry	......	1	2
Machine Construction	......	1	......
Theory of Machines	......	4	2
Mechanical Drawing	......	10	9
Physics and Chemistry	......	......	3
Electro-technics	......	......	8
Electrical Laboratory and Electrical Measurements	......	......	6
Electrical Workshop	......	......	12
Book-keeping	......	1	......

That these courses are clearly not of the highest grade is obvious, from the above programme, and this view is confirmed by a reference to the details of the course.

There is a technical school for mechanics at Horten (not far from Kristiana), specially designed for ordinary mechanicians, and also for those who have to deal with marine engines. Further, there are four special schools for this last purpose, viz., one at Kristiania, one at Kristiansand, one at Bergen, and one at Trondhjem.

The higher technical school of Kristiania will be referred to in Chapter LIV hereinafter.

Sweden.

22. *Lower Technical Schools in Sweden.*—The object of the lower technical schools is to prepare for industrial callings by affording both the necessary theoretical and practical instruction of a technical character. The oldest of them is the school of Malmö (1853), three others—Norrköping, Örebro,[1] and Borås[2]—following three years after (1856). The present law governing them is dated 15th June, 1877, and they are over thirty in number. The courses of instruction vary with the locality and conform to local industrial needs. Thus there is a weaving school[3] at Borås. The

[1] See, Redogörelse för Örebro tekniska elementarskola, läsåret, 1901-2. Also, Katalog för tekniska Elementarskolan i Örebro, läsåret, 1902–3.

[2] See, Redogörelse för Borås tekniska elementarskola, 1901-2.

[3] See, Redogörelse för väfskolans i Borås, 1901-2.

The courses in the lower technical schools embrace the following subjects, but, as above indicated, are not represented in each school:—

Mathematics.—Arithmetic, algebra, planimetry, stereometry, series, logarithms, plane trigonometry, elements of analytical geometry, descriptive geometry with linear drawing, practical surveying, plan of a plot of land, levelling with practical exercises and plans.

Mechanics.—Statics and dynamics, science of machinery, drawing of parts and the whole machine, mechanical technology.

Physics.—Principal experimental applications of physics from the point of view of industry. Inorganic and organic chemistry with laboratory practice, chemical technology. Mineralogy and geognosy.

Languages.—Swedish, German, English, or French, as the Director decides.

Other subjects.—Book-keeping, commercial science, architecture, freehand drawing, modelling, workshop practice, gymnastics, fencing, etc.

The school year is thirty-six weeks, and the complete courses last three years. Pupils must be at least 14 years of age on entry into the classes, and are admitted by examination.

23. *Technical School at Eskilstuna.*—This school, created in 1855 under its present name, was enlarged in 1872, and in 1890 took on its present form of activity.

The courses in the evening and on Sundays embrace mathematics as in the preceding section, excepting, however, analytical geometry, mechanics, physics and chemistry, omitting technological chemistry, Swedish, German *or* English, caligraphy, freehand drawing and modelling, book-keeping as applied to particular industries, and architecture.

In the special branch of the school for the iron and steel industries the courses embrace the following, viz.:—Freehand drawing with special regard to various styles, modelling, wood engraving, etching by nitric acid, chasing, engraving generally, metal founding, electroplating, forge work, lathe-turning, and general practice in mechanical workshop.

There are about 150 pupils in the former and about thirty pupils in the latter branch of the school.

24. *Technical School of Stockholm*[1].—This school (*Tekniska Skola*), started in 1844 as a private school, was several times enlarged, and became a State school in 1860. In 1878-9 it was reorganised and took on practically its present form.

It has now five sections, viz.:—

(1) Evening and Sunday morning technical school. (Tekniska afton och söndagsskolan.)
(2) Technical school for young women. (Tekniska skolan för kvinliga lärjungar.)
(3) School of Art-industry. (Högre konstindustriella skolan.)
(4) Professional school of building and architecture. (Byggnadsyrkesskolan.)
(5) Mechanics school. (Maskinyrkesskolan.)

The courses, however, include artistic embroidery, painting, decorative painting, photogravure, anatomy, and anatomical drawing, etc.

The school has in all nearly 2,000 students, and its budget is about as follows:—

Annual State subsidy	97,075 kronor.
„ Municipal subsidy	7,500 „
„ Fees	15,000 „
„ Miscellaneous	3,425 „
Total	123,000 „

This is about £6,833 per annum.

The scheme of instruction is very complete, and a full outline is desirable.

25. *Evening and Sunday Technical Schools, Stockholm.*—The following are the courses and the subjects that are required to be taken:—

(i) *For Mechanicians.*—Freehand drawing, elementary course, 1st and 3rd division; geometrical drawing[2]; arithmetic; algebra; geometry; experimental physics; trade commodities; mechanical technology; *mechanics* and the *theory of mechanisms*; *mechanico-technical drawing.* Optional, correspondence, etc.,[3] book-keeping, architectural drawing.

(ii) *For House Builders.*—Freehand drawing, elementary course, 2nd division; geometrical drawing; theory of perspective, 1st division; arithmetic, 3rd division; trade commodities, 2nd division; *theory of building construction*; architectural drawing. Optional, correspondence, etc., and book-keeping.

(iii) *For Technical Chemists.*—Arithmetic, 3rd division; freehand drawing, elementary course, 1st and 3rd divisions; experimental physics, *chemistry and chemical technology*; trade commodities, geometrical drawing, 2nd division. Optional, correspondence, etc., and book-keeping.

(iv) *For Electro-Technical Workers.*—Arithmetic; algebra; geometry; *experimental physics*; trade commodities; geometrical drawing, 3rd division; freehand drawing, elementary course, 1st and 2nd division; mechanico-technical drawing; mechanics and theory of mechanisms. Optional, correspondence, etc., and book-keeping. (v)

[1] See Berättelse (also Meddelanden), rörande tekniska skolans i Stockholm verksamhet och tillstand, läroåret, 1900–1. The Meddelanden gives a very complete account of the details of the courses; it gives also the history of the Institution.

[2] Where not otherwise specified, the subject is to be taken in its entirety, thus this subject is in the *Studieplan* entered as "*geometrisk konstructionsritning, hela.*"

[3] *Uppsatsskrifning.* There are three divisions.

(v) *For Mathematical and Physical Instrument Makers.*—Freehand drawing, elementary course; 1st and 3rd division; arithmetic; algebra; geometry; experimental physics; trade-commodities; workshop instruction; *geometrical drawing*, 3rd division; mechanics and theory of mechanisms; mechanico-technical drawing. Optional, correspondence, etc., and book-keeping.

(vi) *For Tinsmiths and Sheet-Metal Workers.*—Freehand drawing, elementary courses, 3rd division; *geometrical drawing*, 3rd division; industrial-art drawing, 3rd division; ornament modelling, 1st division; mechanical technology and workshop instruction. Optional, correspondence, etc., and book-keeping.

(vii) *For Artistic Smiths and Iron-workers.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; geometrical drawing; *art-industrial drawing*, 4th division; ornament modelling, 2nd division; mechanical technology, with workshop instruction.

(viii) *For Metal Engravers.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; geometrical drawing, 3rd division; ornamental lettering and caligraphy, 2nd division; art-industrial drawing, 3rd division; ornament modelling, 1st division; *engraving on metal*; 2nd year course in the higher art-industrial schools programme.

(ix) *For Embossing, Chasing, etc.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; geometrical drawing, 3rd division; art-industrial drawing, 3rd division; ornament modelling, 2nd division; figure modelling, 2nd division; *embossing and chasing*, 2nd year course in highest art-industrial school.

(x) *For Sample-drawing.*—Freehand drawing, elementary course, 4th division; geometrical drawing, theory of perspective; painting, 2nd division, ornament lettering with caligraphy; art-industrial drawing, 4th division.

(xi) *For Tapestry-workers, Upholsterers, etc.*—Freehand elementary course, 3rd division; geometrical drawing, 3rd division; painting, 2nd division; *art-industrial drawing*, 4th division (draperies).

(xii) *For Xylography and Lithography, etc.*—Freehand drawing, elementary course, 4th division; figure-drawing, 3rd division; geometrical drawing; theory of perspective; *art-industrial drawing*, 4th division; ornamental lettering and caligraphy; painting, in distemper (i vattenfärg) for lithographers, 2nd division.

(xiii) *For Map-drawing.*—Freehand drawing elementary course, 3rd division; geometrical construction drawing, 3rd division; ornamental lettering and caligraphy, 2nd division; art-industrial drawing, 3rd division; pen-drawing, etching, map-drawing.

(xiv) *For Modellers.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division (or complete); geometrical drawing, 2nd division; art-industrial drawing, 3rd division; *ornament modelling* (or alternative *figure modelling*).

(xv) *For Wood-carvers.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; geometrical drawing, 2nd division; art-industrial drawing, 3rd division; ornament modelling, 1st division; figure modelling, 2nd division; *wood-carving*, 2nd year course in the higher art-industry school.

(xvi) *For Furniture and Cabinet-makers* (*möbelsnickeri*).—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; geometrical construction, 3rd division; perspective, ornament modelling, 1st division; art-industrial drawing with furniture drawing; optional, correspondence, etc., and book-keeping.

(xvii) *For Decorative Painters.*—Freehand drawing, elementary course, 4th division; figure drawing, 2nd division; geometrical drawing; perspective; ornamental lettering and caligraphy; art-industrial drawing, 4th division; *painting*. Optional, correspondence, etc., and book-keeping.

(xviii) *For Marbling, Graining, and Sign Painting* (*marmorering och ådring samt skyltmålning*).—Freehand drawing, elementary course, 2nd division; geometrical drawing, 1st division; ornamental lettering and writing; *painting marble, wood, etc.*, or (alternative) *sign painting*; correspondence, etc. Optional, book-keeping.

(xix) For book-keeping, arithmetic, 2nd division; correspondence, etc.; ornamental lettering, and caligraphy, angular and round styles, 3rd division; trade commodities; book-keeping.

To understand the previous courses, it should be mentioned that nearly all the subjects have a large number of divisions, the work being either different or of different grade. The following indicates the divisions, and the hours per week devoted to each subject:—

Geometrical Drawing, linear drawing and descriptive geometry has four divisions, to which 19 hours per week are devoted.
Perspective, 2 divisions, 2 hours per week.
Freehand drawing, elementary course, 4 divisions, 17 hours per week.
Figure and landscape drawing, 3 divisions, 6 hours per week.
Art-industrial professional drawing has two branches, in the first four divisions, and in the second, 3 divisions, 15 hours per week in all.
Painting has 3 divisions, 4 hours per week.
Ornament-modelling, two branches, 3 divisions in the first and 2 in the second, in all 10 hours per week.
Figure-modelling, 4 divisions, 6 hours per week.
Arithmetic, 3 divisions, 11 hours per week.
Algebra, 3 divisions, 8 hours per week.
Geometry, 3 divisions, 6 hours.
Mechanics and theory of mechanisms, 2 hours per week.
Mechanico-technical drawing, 2 divisions, 13 hours per week.
Experimental physics, 3 divisions, 4 hours per week.
Chemistry and chemical technology, 2 divisions, and 7 hours per week.
Trade commodities, 1½ hours per week.
Mechanical technology, with workshop instruction, 3 hours per week.
Theory of building construction with drawing, 2 divisions, 6 hours per week.
Architectural drawing, theory of architectural forms, 6 hours per week.
Correspondence, etc. (?)
Writing, etc., business forms, 3 divisions, 6 hours per week.
Book-keeping, 3 divisions, 6 hours per week.
Ornamental writing and caligraphy, 3 divisions, 6 hours per week.
General caligraphy, 2 hours per week.
Engraving in wood, chasing and engraving, 12 hour per week.

26. *Technical School for young Women, Stockholm.*—The following courses have been developed for young women in the Technical School of Stockholm (*Tekniska skolan för kvinliga lärjungar*) :—

(i) *Art-industrial designs.*—Freehand drawing, elementary course, 3rd division; figure drawing, 1st division; geometrical drawing, 3rd division; painting, 2nd division; ornamental lettering and caligraphy, 2nd division; *art-industrial drawing*, 4th division.

(ii) *Art-industrial designs* (2nd course).—Freehand drawing, elementary course, 4th division; figure drawing, 2nd division: geometrical drawing; whole course; perspective; painting, ornamental lettering and caligraphy, complete; *art-industrial drawing*, 4th division.

(iii) *Modelling.*—Freehand drawing, elementary courses, 3rd division; figure drawing, 2nd division; (when figure modelling is the chief subject, figure-drawing complete); geometrical drawing, 2nd division; art-industrial drawing, 3rd division; *ornament modelling* complete (*figure-modelling*, complete, as alternative).

(iv) *Wood-carving.*—Freehand drawing, elementary course, 3rd division; figure drawing, 2nd division; art-industrial drawing, 3rd division; geometrical drawing, 2nd division; ornament modelling, 2nd division; figure modelling, 1st division; *wood-carving*, 2nd year course of the higher art-industrial school programme.

(v) *Decorative painting.*—Freehand drawing, elementary course, 4th division; figure drawing, 2nd division; geometrical drawing; ornamental writing with caligraphy, perspective, art-industrial drawing, 4th division; *painting*. Optional, correspondence, etc., book-keeping.

(vi) *Metal-engraving.*—Freehand drawing, elementary course, 3rd division; figure-drawing, 2nd division; geometrical construction, 3rd division; art-industrial drawing, 3rd division (without water-colour) ornament modelling, 1st division; ornamental lettering and caligraphy, 2nd division; *engraving on metal*, 2nd year course of the higher art-industrial school programme.

(vii) *Embossing and chasing.*—Freehand drawing, elementary course, 3rd year; figure drawing, 2nd year; geometrical drawing, 3rd year: art-industrial drawing, 3rd division; figure modelling, 2nd division; *embossing and chasing*, 2nd year course in the higher art industrial school programme.

(viii) *Artistic embroidery.*—Freehand drawing, elementary course, 2nd division; geometrical instruction, 1st division; painting, 2nd division; ornamental lettering and caligraphy, 1st division; (alternative, 2nd division); art-industrial drawing, 3rd division; *artistic embroidery*, 3rd division.

(ix) *Xylography and Lithography.*—Freehand drawing, elementary course, 4th division; figure drawing, 3rd division; geometrical drawing; perspective; *art-industrial drawing*, 4th division; ornamental lettering and caligraphy, painting in distemper for xylography, 2nd division.

(x) *Plan and Map-drawing.*—Freehand drawing, elementary course, 3rd division; geometrical drawing, 3rd division; ornamental lettering and caligraphy, 2nd division; art-industrial drawing, 3rd division; plan drawing (etching and map printing).

(xi) *Book-keeping.*—Arithmetic, 2nd division; correspondence, etc., ornamental lettering and caligraphy, angular and roundhand, 1st division; physics, general and trade commodities, *book-keeping.*

The following are the divisions and hours per week of the different subjects:—

Programme "Tekniska Skolan för kvinliga lärjungar, Stockholm."

Subject.	Divisions.	Hours per Week.
Geometrical Drawing with Linear Drawing and Descriptive Geometry	3	6
Theory of Perspective	2	2
Freehand Drawing	4	12
Figure and Landscape Drawing	3	4
Art-industrial Drawing...	4	8
Painting Ornaments, from nature, etc.	3	4
Ornament, Modelling (I and II)	3–2	7
Figure Modelling	4	5
Arithmetic	3	8
Geometry	2	2
Physics and Trade Commodities	2	3
Correspondence, Business forms, etc....	3	4
Book-keeping, single and double entry	3	4
Ornamental Lettering and caligraphy	3	4
General Caligraphy	1	2
Wood-carving	1	12
Chasing and Engraving...	1	12
Artistic Embroidery, etc.	1	9

27. *The Higher Art-industrial School, Stockholm.*—This branch of the Stockholm technical school is known as the "*Högre konstindustriella Skolan*," in Swedish. It is for pupils of both sexes.

An account of the general scheme can be exhibited by giving the general plan of studies (studieplan) which is as hereunder for the divisions of the first branch (*Första hufvudafdelningen.*)

This

The courses for the above will be sufficiently indicated in the general time-table hereunder :—

Programme of the "Maskinyrkesskolan" in the Technical School of Stockholm.

Divisions.	Year.	Courses, and Hours per Week. Geometrical Drawing with Linear Drawing.	Freehand and Ornamental Drawing.	Arithmetic, Algebra. Geometry.	Surveying.	Experimental Physics.	Chemistry and Chemical Technology.	Trade Commodities.	Mechanics and Theory of Mechanism.	Mechanical Technology and Workshop Instruction.	Mechanico-technical Drawing.	Architectural Drawing and Theory.	Correspondence.	Book-keeping.	Modelling.
Division I. Mechanics, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	4	2	...	...
	II	2	...	6	...	$1\frac{1}{2}$	...	$1\frac{1}{2}$	3	3	12	(3)	...	2	...
	III	...	...	...	2	...	...	...	3	3	15	...	...	...	...
Division II. Millers, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	4	2	...	...
	II	2	...	6	...	$1\frac{1}{2}$	...	$1\frac{1}{2}$	3	3	12	3	...	2	...
	III	...	...	...	2	...	...	...	3	3	15	...	...	...	...
Division III. Mechanics, Boiler-makers, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	(4)	2	...	...
	II	...	...	...	...	$1\frac{1}{2}$	...	$1\frac{1}{2}$	3	3	15	...	...	2	...
Division IV. Ship-builders.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	4	2	...	...
	II	...	...	...	2	$(1\frac{1}{2})$	...	$1\frac{1}{2}$	3	3	15	...	...	2	...
Division V. Bridge-builders, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	4	2	...	...
	II	...	...	...	...	$(1\frac{1}{2})$	...	$1\frac{1}{2}$	3	3	15	3	...	2	...
Division VI. Iron-founders, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	(4)	2	...	...
	II	...	4	...	...	$1\frac{1}{2}$	...	$1\frac{1}{2}$	3	3	15	...	...	2	4
Division VII. Electro-technical Workers, etc.	I	4	2	8	...	$1\frac{1}{2}$	$1\frac{1}{2}$	...	...	...	12	4	2	...	..
	II	...	...	...		$2\frac{1}{2}$	...	$1\frac{1}{2}$	3	3	15	...	...	2	...
	III	...	...	...	2	2	...	...	3	3	15	...	...	...	...

30. *Special Courses, Technical School, Stockholm.*—Beside the regular courses there are special lectures in the following subjects —

(1) Theory of style and composition of ornament.
(2) Artistical design.
(3) Painting.
(4) Photography.
(5) Form anatomy and drawing.
(6) Course in electro-technics.

It will suffice to mention the details of the last course. The course consists of two parts: (a) theoretical; (b) practical. The theoretical part is as follows :—

Sources of electrical current; continuous current and alternating current; electrical units.

Galvanometers, measurement of insulation, differential galvanometers, Wheatstone's bridge, ampère-meters, voltmeters and their use.

Magnetic lines of force, electro-magnet, Ampère's rule. Electrical induction and induced current; galvanic induction apparatus and the principle of alternating current transformers. Alternating current machines. Gramme's inductorium. Armature reaction.

Series, shunt and compound machines.

Secondary elements and accumulators.

Electrical arc and glow lamps, series and parallel systems. Computations.

Practical work of an electro-technical laboratory and workshop.

The preceding account gives a general idea of the provision made by Norway and Sweden for the lower grades of technical instruction. The higher technical schools will be dealt with in a later part of the Report.

CHAPTER XVI.

CHAPTER XVI.

Technical Education in Sweden.

[J. W. TURNER.]

Introduction.—For the information contained in the following pages the Commissioner is in the main indebted to the recent publication, "Sweden; its People and its Industry," a historical and statistical handbook, published by order of the Government, edited by Gustav Sundbärg, 1904.

Educational Sloyd.

Sweden takes an important part in the movement which, directed against exclusive brainwork at school, strives to make systematically-arranged manual work an important element of rational education. As early as 1870 definite steps were taken to introduce Sloyd instruction, both in already existing schools and in so-called Sloyd-schools, established for the purpose. At the beginning these efforts were confined to private persons, the Government subsidising the movement for the first time in 1877. The Government grant in 1900 to schools teaching Sloyd was 261,750 kronor (£14,396).

By Swedish educational Sloyd is meant the system of instruction and the method worked out at the Nääs Slojdläraresеminarium, where most of those Swedish male and female teachers who impart instruction in carpentering have received their training. Sloyd is also taught at all training-schools for male elementary school teachers, and Sloyd courses for the same class of teachers have, besides, been arranged in several districts by the authorities. These courses are often conducted by Government instructors, who teach, in addition, other branches of domestic industry.

Nääs School.—The Nääs School is supported by the munificent donations of its founder, August Abrahamson. It is situated near the city of Gothenburg, and its present director is Dr. Otto Salomon. It was opened in 1874, as a higher division of the Sloyd school for boys, which two years previously had been erected at Nääs. To begin with, courses of one year's duration were arranged for the training of special Sloyd teachers, and later on, shorter courses were given for elementary school teachers. Since 1882 the instruction consists exclusively of such courses, partly for the training of male and female Sloyd teachers, partly for the training of playmasters. Each of these courses at present lasts six weeks. The instruction is free of cost. The courses include lectures and discussions on the teaching of Sloyd, its educational and historical significance, and on the arrangement of such instruction at schools, in addition to practical work in the Sloyd-room. From 1875 to 1900, 2,493 Swedes have gone through the Nääs Sloyd course, and 853 foreigners, of whom 331 were from England, 58 from Scotland, and 73 from the United States, have taken the Nääs training.

The training of playmasters and the introduction of games into the ordinary curriculum of the public schools of Sweden were features of education to which the Commissioners were introduced during their visit to the Nääs Training-school. These subjects form part of the regular instruction given in that institution. Dr. Salomon, the Director of Nääs, whose kindness and hospitality to visitors are well known, arranged to meet the Commissioners in Stockholm, and give them a demonstration of his system of games in one of the public schools of that city. The Director was most anxious that this feature of his work should be understood. The games are divided into outdoor and indoor practices, and both were seen. The Director claims for his indoor games—which are, in reality, an exposition of pretty, graceful movements entering into the old Swedish dances—that they affect beneficially the home life of the girl who seeks her enjoyment in the domestic circle, which she prefers by reason of the physical training taught in the school. She is thus protected from the dangers into which many girls fall who seek their pleasures too early away from the parental roof. Physical culture throughout Sweden is in a high state of efficiency, and the training afforded by these games has no small share in building up a robust physical condition in the Swedish boys and girls attending the schools for the masses.

All the pupils who came under notice during the exposition at the Maria Folkschola, Girls' Department, were extremely graceful and neat in their carriage. On the physical side the Director pointed out that the pupils improved in health, for the dances and games, and singing, which always accompanies the former, brought many muscles into play; and on the ethical side such practices instilled and perpetuated love of old customs and made for sound national sentiment. Some of the dances and songs are 400 years old. The demonstration took place in a splendid hall in the school, and all orders were given by the mistress. The children participating were girls from 12 to 14 years of age. The instruction occupies less than an hour each week. The out-door games are also on a systematic basis.

Sloyd instruction for educational purposes is in Sweden taught chiefly to boys from 10 to 14 years of age, and that is the reason why at Nääs the Sloyd instruction has been limited to Sloyd *carpentry*, as being the most suitable for pupils of that age. In some schools, however, cardboard and metal Sloyd, turnery and wood-carving are also taught.

One of the finest public schools in Europe is the Folkskola, Ostermalms, Stockholm. The buildings are quite new, of three stories, with accommodation for 1,000 boys and 1,000 girls. The main entrance is wide, and a double staircase leads to the upper rooms. The buildings surround a playground, square-shaped, large, and gravelled. The principal's house is on the premises. The class-rooms branch off from wide corridors. The cookery classes are conducted on the family principle, each family of girls with its own stove, table, etc. The same plan prevails in other parts of Northern Europe. The senior boys take Sloyd metal and wood, the juniors work with cardboard. The work in cardboard, which is most systematically taught, supplies in this school the link between the Kindergarten and the advanced Sloyd. The teaching of this branch of manual training in this school impressed the Commissioners very much. For general organisation, equipment, and method, the Ostermalms Folkschola stands among the best schools of its class in Europe.

The

The educational Sloyd claims its place at the schools as an element of general education. Its object is not to train cabinet-makers or other artisans. Its aim is, on the other hand, the moral, intellectual, and physical development of the pupil by teaching him orderliness, attentiveness, and perseverance, by training his eye to see better, and his hand to work better, and above all, by giving, together with gymnastics, a healthy counterbalance against one-sided book work. "Quality, not quantity" is the motto of pedagogical Sloyd, for which reason it does not require of children many and large pieces of work, but the greatest possible accuracy in arriving at a result, which is gained by beginning with comparatively simple models, and by only gradually, in progressive order, passing on to more complex work.

The Nääs method is based on what is called exercises. By exercises in this connection is to be understood the manipulation of the materials by means of one tool or more, in a definite way, for a definite object. Theoretically speaking, an unlimited number of such exercises may, of course, be conceived, but the question in this case being the arranging of a method pertinent to practical instruction, a restriction is necessitated, and that is why the Nääs school demands only sixty-eight such exercises. With a good form from an æsthetical point of view, the objects made must unite a practical purpose, and thus, in order to strengthen the bond between the home and the school, hardly any article but those likely to prove useful either to the children themselves or to their parents are, as a rule, produced. Articles of pure luxury are altogether excluded.

The educational Sloyd will also teach the pupil self-reliance and arouse his faculties of observation and reflection. By letting practice precede theory, and handiwork go before explanations, the child is put into the custom of thinking its own thoughts while doing its own work independently. Contributory to this purpose is the pervading rule that the teacher certainly must carefully lead and supervise the work of the pupils, but, at the same time, be on his guard against more or less carrying out any part of it himself. As far as possible, drawing ought to go hand in hand with Sloyd, so that the pupils, after having learnt the first elements of drawing, are allowed to execute their work from drawings. The main object of the instruction being the individual development of the pupil, not the acquiring of technical skill, individual and not class teaching is applied.

Workshops for Children in Sweden.

These institutions, which were started by private initiative, must not be confounded with workshops attached to manual training schools. They are a kind of day schools, in which an opportunity is given to poor children during their leisure hours to occupy themselves in a useful way, learning practical work and various trades.

The workshops, which are now established in every district in Stockholm, are each under the management of its own special board, which organises the instruction and superintends the work. A central committee, to which every board elects one member, manages the common concerns, publishes annual reports, arranges classes for teachers, lends models for work, etc. Poor children, from 7 to 14, who are not looked after at home, are received in the workshops, on the proposal of the board school teachers, and are taught there from 11 a.m. to 1 p.m. (the youngest children), and from 5 to 7 p.m. (the older ones). The former get their dinners, the latter their suppers, as a remuneration for the work. The cost for the dinner amounts to 8·13 öre (7·6 öre = 1 penny), that for the supper to 3·8 öre per child.

The staff of teachers consists partly of voluntary, partly of paid, lady-teachers, and of artisans skilled in their professions. Last year, the number of voluntary lady-teachers amounted to seventy-eight and that of paid teachers to seventy-two. The workshops are managed at a very small cost. They are supported by subventions from the Town Council and parish grants, by private gifts, and by sale of the children's work. The income at the annual joint sale of these amounts from 5,000 to 7,000 kronor (£275 to £385). The annual grant from the Town Council for all the workshops of Stockholm amounts to 25,000 kronor (£1,375), that of the parishes from 300 (£16 10s.) to 1,200 kronor (£66) for each shop.

Aims of these Schools.—While the object of the Sloyd pursued at the schools is chiefly a pedagogical one, the work at these shops aims more at *manual skill* and practical usefulness. The boys are taught brush-making, fret-work, wood-carving, basket-work, joinery, tailoring, cobbler's work, and metal work. The girls make slippers, baste shoes, chip plaits for hats and baskets; besides, they weave, make dr[illegible]es and underclothing, and also learn to mend their own garments. In two districts in the city of Stockh[illegible]lm the shops are combined with a school kitchen; in all the shops the children help in the kitchen and assist in sweeping and dusting the rooms.

The children are also allowed to take home material for sundry easy works, which they do at home and for which they are paid out of the means of the workshop; their wages are put into the Post Office Savings Bank for them. On such home-work, which is highly in demand amongst the children, and given as an encouragement and reward only to the good and most industrious, they can earn from 8 to 20 kronor a term (8s. 10d. to 22s.). The average cost for each child in the workshops of Stockholm was, during the first ten years, 13·7 kronor per annum (15s.), but has somewhat increased these last years. The number of children in the twelve workshops of Stockholm is from 60 up to 262 in each.

Workshops have been started also in other Swedish towns, at present reaching the number of thirty-three. They are organised on the same principles as those of Stockholm. At their foundation, they get for the first setting-up a grant of 700–1,000 kronor (£37 to £55) from the Institution Lars Hierta's Memorial Funds.

During the sixteen years that have elapsed since such workshops began, the moral and educational value of manual training has been proved. The good results of the work have also become obvious and are generally acknowledged. In the capital alone, about 1,600 of the poorest children have in these workshops, during their leisure hours, found a refuge, where they are put to a useful occupation instead of roaming about in the streets and markets and being exposed to the temptation of begging and pilfering. The workshops, where the children, besides enjoying motherly care and education, acquire manual skill and quickness of perception and learn useful trades, have proved one of the best *preventive means against the vagrancy and criminality* of the young. Thousands of children, amongst whom many come from the worst of homes, have thus been brought into safety without having had to be taken from their parents and put into orphanages or reformatory or industrial schools.

Technical Education.

Technical education at the present moment holds a very high position in Sweden. Higher scientific instruction in technical subjects is imparted at the Technical High School in Stockholm and at the higher division of Chalmers' Polytechnical College in Gothenburg. In the second rank follow the lower division of the Chalmers' College, five technical colleges in different parts of the country, and a special Technical School at Eskilstuna. A multifarious instruction and education are offered at the Technical School in Stockholm; finally, there are about forty lower technical schools in smaller towns.

The Technical High School, Stockholm.

Constitution.—The Chairman of the Board is appointed by the Government, likewise four members of the Board on proposal of the Council of Teachers at the school; one member is appointed by the Commissioners of the Iron Institute; an *ex-officio* member of the Board is the principal of the school. The school is subsidised by the Government.

Pupils.—The pupils of the High School are partly *regular* ones, who, on entrance, have given proof of possessing the necessary preparatory education, and who follow the instruction to the extent necessary for obtaining a full certificate of competence; partly *special* students, who follow the instruction in fewer subjects, and who, on entrance, have shown that they possess a certain amount of knowledge prescribed by the Board; these have the right to obtain certificates in those subjects they have studied; and, finally—in case of places being found at disposal—*outsiders*, who, without having presented certificates of insight, and without admittance examination, receive instruction in subjects chosen by themselves; these have no right to a certificate. For regular pupils, the term fee is 50 kronor.

Admission.—The admission requirements demand producing a final diploma, either from a higher State college in the scientific lines, or from the classical line, with supplementary credits in mathematics, physics, chemistry, geometrical and freehand drawing, or from a technical college with supplementary credits in Swedish, foreign modern languages, history, and geography.

Staff.—The instruction is imparted by twelve professors, nominated by the Government after proposal of the Board, ten masters in ordinary appointed by the Board, thirteen associate masters and three lecturers commissioned by the Board, assistants, and associate-assistants.

Syllabus.—The High School includes special divisions for—

A. Machine design and mechanical technology, with a triennial or quadrennial course, or else naval engineering.
B. Electrotechnics.
C. Chemical technology, with a triennial course.
D. Mining—divided into—
   1. Classes for mining mechanics, with a quadrennial course.
   2. Metallurgy and smelting, with a triennial or quadrennial course.
   3. Mining proper, with a triennial or quadrennial course.
E. Architecture, with a quadrennial course and the instruction so arranged that the pupils, after three years' study, have the right to proceed with their studies at the Academy of Arts.
F. Civil Engineering, with a quadrennial course.

Subjects of instruction.—

(a) Pure mathematics, embracing the theory of equations and of determinants, analytical geometry, the differential and integral calculus, differential equations, and the elements of the method of least squares.
(b) Descriptive geometry.
(c) Geodesy and topography.
(d) Theoretical mechanics, with an elementary and a higher course.
(e) Descriptive mechanics, together with mechanical construction and the construction of simple parts of machines.
(f) The theory of practical mechanics and mechanical construction, with the necessary exercises in construction.
(g) Mining mechanics.
(h) The theory of steamship construction.
(i) Mechanical technology, with strength tests and mechanical laboratory work.
(j) Physics.
(k) Applied pyrology.
(l) Theoretical and practical electrotechnics.
(m) General and analytical chemistry, and chemical technology, with chemical and chemico-technical laboratory work.
(n) Electro-chemistry, with laboratory exercises.
(o) Zymology.
(p) Mining chemistry.
(q) The metallurgy of iron and other metals.
(r) The art of smelting, metallurgical laboratory work.
(s) Mineralogy and geology.
(t) Mining.
(u) General theory of building, building statics, house building, architecture, history of the art of building.
(v) Civil Engineering.
(w) Geometrical drawing, freehand drawing.
(x) Decorative designing; modelling.
(y) Political economy and commercial law.
(z) Technical hygiene and workshop practice.

An institution for the testing of materials, with a Director of its own, has been established in connection with the mechanical laboratory. Its object is to test metals, building-stone, cement, and, above all, the strength of various building materials. And such tests are made also for the public, according to taxes and regulations fixed by Government.

Chalmers'

Chalmers' Polytechnical College.

Constitution.—This college dates its origin from a donation of 105,689 kronor (1·1 shilling), made in 1811 by William Chalmers, for the establishing of an industrial school under the control of the Board of the Freemason Orphanage in the city of Gothenburg. It is subsidised by the State. The Board consists of seven members, viz., the Governor of the Province as Chairman, the Bishop of the Diocese, the Principal of the College, one manufacturer, and three of the members of the Board of the Freemason Orphanage.

Courses.—At present the college is divided into a lower division, with a triennial course, and a higher division, with a triennial course, and subdivided into five sections or professional schools:—

(a) Mechanics.
(b) Electrotechnics.
(c) Technical chemistry.
(d) Art of building.
(e) Shipbuilding.

The instruction is conducted by seven masters in ordinary (one of whom is the Principal besides, and has the title of Professor), and twelve other teachers and assistants. The attendance of students approaches 500.

Syllabus.—In the higher division of the college the instruction embraces chiefly the same subjects as in the Technical High School in Stockholm (with the exception of those referring to mining), and theoretical and practical shipbuilding, ship construction, and measurement of vessels besides. The pupils are classified on the same principle as at the High School, into regular, special, and outside students. The admission requirements consist either in a final diploma from a higher State College or in special examinations in mathematics, Swedish, German or English, history, and geography.

Subjects of Instruction.—The subjects of instruction in the lower division are:—

(a) Arithmetic.
(b) Algebra, equations of the first and second degrees, with problems maxima and minima.
(c) Logarithms.
(d) Plane trigonometry.
(e) Geometry, with the theory of proportions.
(f) Planimetry and stereometry.
(g) Elementary physics and chemistry.
(h) Electrotechnics.
(i) Elementary mechanics.
(j) The principles of the theory of practical mechanics.
(k) The manufacturing of iron and wood.
(l) The principles of theoretical and practical shipbuilding.
(m) Geometrical and freehand drawing.
(n) Modelling.
(o) Swedish.
(p) German.
(q) Book-keeping.
(r) Metal and wood working in the shop.

In connection with this college there is an institution for testing materials. It receives a small annual grant from the State.

TECHNICAL COLLEGES.

The five technical colleges in the lower grade impart both theoretical and practical instruction in the elementary branches of technical knowledge to those who intend to devote themselves to industrial pursuits.

Constitution.—The Board at each of the technical colleges consists of a chairman, and one member appointed by the Government, the head master, and two members appointed by the Town Council.

Courses.—The course of instruction covers three years; the school-year consists of 36 weeks. The minimum age of entrance is fixed at 14. The admission examination embraces Swedish, mathematics, history, and geography. Youths who have passed the fifth class of a State college, with certificates of knowledge in these subjects, are exempt from the admission examination within a space of two years after leaving the college. The admission fee is 10 kronor; the term fee, 10 kronor at most.

Subjects of Instruction.—The subjects of instruction according to statute must comprise—

I. Mathematics—
(a) Arithmetic, algebra, plainmetry, stereometry, the theory of series and logarithms, plane trigonometry, and the first principles of analytical geometry;
(b) Descriptive geometry, together with geometrical drawing;
(c) Practical geometry, surveying, levelling, with drawing and field exercises.

II. Mechanics—
(a) The laws of the equilibrium and movement of bodies;
(b) The theory of mechanics, machine-drawing, and design of simple machines and parts of machines.
(c) Mechanical technology.

III. Natural philosophy—
Experimental physics—with reference to the most important applications of that science in industries.

IV. Chemistry, inorganic and organic, with laboratory work, and chemical technology.
V. Mineralogy and geognosy.
VI. Swedish and German, English or French, according to the final decision of the different Boards of Directors.
VII. Book-keeping and the science of commerce.
VIII. Building.
IX. Freehand drawing and modelling.
X. Work in the workshop.
XI. Gymnastics and exercise of arms.

The

The Technical School of Eskilstuna.

The Technical School of Eskilstuna has two sides—the Sunday and Evening School in operation for many years, and the Professional School for finer cutlery and metal industries of recent growth.

Curriculum.—In the older division the instruction embraces mathematics as at the technical colleges, with the exception of the first principles of analytical geometry; mechanics, natural philosophy, and chemistry, as at the technical colleges, chemical technology excepted; Swedish, with composition; German or English; copywriting; freehand drawing and modelling; book-keeping, to meet the requirements of industries; building. In the Professional School for cutlery and metal industries, the subjects of instruction are—freehand drawing with the principles of style, modelling, wood-carving, engraving, metal-casting, enchasing, embossing, etching, galvanizing, forging, filing, and turning. The attendance in the Sunday and Evening School approaches 200, and in the Professional School is about 40.

The Technical School of Stockholm.

The School Board consists of a chairman, the director of the school, and one member (appointed by the Government), and four other members appointed by the Town Council, the Council of Teachers at the Technical High School, the Academy of Arts, and the direction of the Swedish Industrial Art Society. The school-work is carried on in five head departments:—

Departments—

I. The Technical Evening and Sunday School.
II. The Technical School for Females.
III. The Higher Industrial Art School.
IV. The Professional Building School.
V. The Professional School of Mechanics.

Besides, instruction is imparted in the principles of style, art needlework, professional and decorative painting, photography, form anatomy with drawing, a course for electrical fitters, and gymnastics.

Attendance.—The students attending the Technical School of Stockholm number upwards of 2,000.

Staff.—The staff numbers nearly 100. At present a plan is being worked out with the purpose of a further extension and comprehensive changes in the organisation of the school, chiefly by dividing it into several educational institutes in different parts of the city.

Lower Technical Schools

The lower technical schools, whose activity varies according to the special branches of industry prevalent in the districts where they are located, number over forty. They are supported mainly by the communities of these places, but stand under State inspection, and also receive State grants.

Polytechnic instruction occupies a high place in the educational policy of the country, but it is admitted that the *pure practical training* has been, in some degree, neglected. To mend matters, the Town Council of Stockholm, a few years ago, appointed a committee to investigate the case, and bring forward a proposal for the improvement of the practical instruction in mechanical arts. Experts have, therefore, been sent abroad for the purpose of studying ths question, and printed forms, with questions, have been sent round to the chief manufacturers and employers of artisans, in order to learn their opinion in the matter. The work of the committee is not yet finished (it was commenced in April, 1901, and the date of this report is February, 1904), but there is good hope that the result will be the founding of a number of professional schools, where the instruction should be given in *technical evening classes*, specialised more than at present for each different branch, and in exclusively practical, elementary *classes for mechanics*, as well as *industrial schools for women.*

Agricultural Education.

In the year 1900 a special Department of Agriculture, divided into two bureaux, one attending to agricultural matters, the other to forestry, was established in Sweden.

The institutions affording instruction in agriculture stand under the control of the Royal Board of Agriculture, and are of three types:—

A. Agricultural schools, giving practical and theoretical instruction in the subject, partly beyond the elementary education;
B. Farmers' schools, affording a theoretical education in the trade;
C. Agricultural high schools, providing advanced teaching in the branch.

The Agricultural Schools.—The agricultural schools afford training and promote skill in the practical carrying out of the various kinds of farm labour, and, in some degree, give instruction in theoretical principles. The pupils, about 350 in number, have to enter into all species of labour on a farm, and have to do duty besides as foremen. Indeed, the training of the pupils to become directors of labour may be regarded as the most important task of these schools. There are at present twenty-six agricultural schools in Sweden. They are usually to be found on some private estate, and for the most part placed under the special direction of the agricultural society of the district: they derive an annual grant from the State of 4,000 kronor each. The course of instruction extends over two years, for advanced pupils over one year. Those entering must have reached their 18th year, be accustomed to farm work, and have passed through the course of a common school. Instruction, board and lodging are provided free of cost.

The Farmers' Schools.—The Farmers' Schools give a theoretical form of instruction. They are most frequently stationed at the People's High Schools, and form a continuation course for pupils at these. (The People's High Schools in Sweden are institutions which only exist in the three kingdoms of Scandinavia, and also in Finland. Their purpose is to furnish *adult* members, especially of the peasantry, with an education at once civil, patriotic, and practical.)

The time devoted to study at these schools is, as a rule, from five to six months, during winter. For entrance, a pupil must have reached his 18th or 20th year and be able to show a certain degree of preliminary knowledge on the subject, equal to that acquired at the People's High Schools, and to have besides, devoted at least one year's work to the pursuit of agriculture.

Agricultural High Schools.—The Agricultural High Schools are designed to afford higher instruction in the principles underlying the exercise of farm-management. The course of instruction is a two years' one. Candidates for entrance must be at least 18 years of age, have had at least one year's practice as farmers, and possess a certain degree of preliminary knowledge, corresponding to the final examination at a technical college, or to the course given in the upper sixth class on the scientific line at the State colleges.

Subjects of Instruction.—

A. Fundamental subjects—Practical Mathematics, Mechanics, Physics, Meteorology, Chemistry, Geology, Botany and Zoology, the Anatomy and Physiology of Domestic Animals, Field-surveying, with Levelling and Drawing.

B. Chief subjects—Agriculture, Study of Domestic Animals, Dairy-farming; Machine, Implement, and Building Construction; the Theory of Agricultural Economy, and Book-keeping.

C. Subordinate subjects—Care of domestic animals in sickness, Forestry, Gardening, Political Economy, Financial Law, and the Laws on the Communal Self-government.

Staff.—The instruction is given by lecturers and assistant masters One of the lecturers is appointed by the Government to be Warden for a space of five years, and he has to superintend and preside over the High School. The farm work is conducted by a steward under the superintendence of the Board of Directors. It is his duty to demonstrate to the pupils the different features of the work being pursued on the estate. The High School itself and the management of the estate are under the supervision of the said Board, which is appointed by the Government.

The pupils at these colleges have no share in the farm work. They are at their own charges for board at the High School, and contribute to the cost of their instruction to the extent of 100 kronor a year. For pupils who desire to continue their studies at the High School there is a limited number of scholarships, entitling to certain advantages. In 1902 there were two of these High Schools in Sweden, with an attendance of sixty-three pupils.

State Dairy-Schools.

The Dairy-Institute at Alnarp.—The Dairy-Institute at Alnarp embraces two divisions—the Higher Dairy-School and the Common Dairy-School. There is a maximum of twelve pupils every year, two being on the foundation, one in each division. The course covers one year. The higher school has to train teachers in dairy management. The conditions for entrance are the completion of the two years' course at an agricultural high school, and one year's practical experience in dairy-work. The fees are 600 kronor. The common dairy-school trains men to become managers of large dairies. The conditions for entrance are—Candidates must be 19 years of age at least; must possess good certificates from the common school; and must have had at least one year's practical experience of dairy-work in all its branches. The fees are 400 kronor.

The Dairy-School at Atvidaberg.—The Dairy-School at Atvidaberg exists to afford men and women, who have already had experience in dairying and acquired some theoretical knowledge of their business, an opportunity to study further the theory of dairy-economy, the manufacture of butter and cheese, the management of dairy-machines and apparatus, and to learn how to keep memoranda upon dairy management. There are two courses every year—one from 1st November to 1st May, and the other from 1st May to 1st November. At each course there is a maximum of four pupils. Pupils can attend a succession of courses if they so wish. Conditions of entrance:—Candidates must have had practical experience in the management of a dairy, and possess sufficient general knowledge and theoretical understanding of dairy economy to ensure their being able to make profitable use of the instruction given. The fees for the full course are 180 kronor. Additional pupils in cheese-making are admitted for short periods at specially-fixed rates.

The State Dairy Stations.

The State Dairy Stations give practical and theoretical instruction to female pupils, their courses extending over two years. The pupils at these institutions receive board, lodging, and teaching free of charge, and 50 kronor a year besides. The institutions are located at important dairies in different parts of the country, and are twenty-six in number; eighteen of them for the first year's course, which is wholly practical, and eight for the second year, in which both practical and theoretical instruction are imparted.

The Agricultural Societies' Dairy-Schools.

Several of the Agricultural Societies support teaching institutions for female pupils, where these receive board, lodging, and instruction free of charge, and in some cases, too, a small salary. The courses are either for one year or two. They are mainly of a practical character, though theoretical study occupies the later portion, embracing from two to fifteen weeks, according to circumstances.

CHAPTER XVII.

CHAPTER XVII.

Technical Education in Russian Schools.

[G. H. KNIBBS.]

1. *Introduction.*—A general outline of the machinery of public instruction in Russia, including all classes of schools, was given in Chapter VII, pp. 80-85, of the "Interim Report of the Commissioners on certain parts of Primary Education," 3rd December, 1903. That chapter was, however, of an extremely general character, and did not enter into details. Chapter XXVI, pp. 308-314, 6th October, 1904, of the "Report of the Commissioners, mainly on Secondary Education," gave an account of Secondary Instruction, and some slight indication of the teaching in schools of industries, and manufactories, and commercial schools. The present chapter proposes to give more definite information on the scheme of organisation of technical education of Russia.

2. *Organisation of Technical Education in Russia.*—The attempt to introduce method into technical instruction in Russia dates back about forty years, but till 1888 each establishment was developed on its own lines, and there was no general relationship between one establishment and another. In 1883 a scientific committee under the Ministry of Public Instruction was charged with the elaboration of a *general plan* for industrial instruction. The principles for the organisation of industrial schools submitted by this committee were sanctioned by the Czar on the 7th March, 1888. A temporary commission, consisting of representatives of the Ministry of Public Instruction, of Finance, and of the Interior, was charged with determining the localities where such schools should be founded at the cost of the State, and with determining the special features which should be represented in the various schools.

Setting aside the highest forms of technical education, the general organisation of industrial instruction is in three types of schools, which may be called :—

(1) Secondary Technical Schools ; (2) Lower Technical Schools ; (3) Trade Schools.

The Secondary Technical Schools aim at furnishing that type of theoretical and practical education which would qualify for the post of assistants to the engineers and chiefs of industrial establishments.

The Lower Technical Schools aim at affording instruction in the various practical processes of the industries, furnishing at the same time that general knowledge necessary for the direct managers of industrial establishments. The Trade Schools aim at teaching the various handicrafts, and whatever is necessary to make them efficient, to those who intend to become practical workmen.

Obviously the preliminary qualification must be different in the several cases. Admission to the Secondary Technical School is open to those who present the certificate of having passed through five classes of the Realschool. (*See* pp. 309, 310 of the Commissioners' "Secondary" Report.) If that qualification is not possessed, there must be one recognised as equivalent by the Minister of Public Instruction.

Admission to the Lower Technical School can take place on the presentation of the certificate of attendance of an ordinary urban school, or of a district or rural school with two classes.

Admission to the Trade Schools involves only the presentation of a certificate of an elementary school of one class, or that of a parish school.

The industrial or technical schools may be independent, or may be annexed to other schools of various grades, and so also may a preparatory school of general education be annexed to the industrial school.

Roughly speaking, there are five types of secondary schools, viz. :—

Schools for (1) mechanics, (2) chemistry, (3) construction, (4) agronomy, and (5) metallurgy.

The lower technical schools are of three special types, dealing with (1) construction, (2) mechanics, (3) chemistry.

In connection with industrial education there are also *apprentice schools*, and what may be called *primary technical schools.*

The whole category of schools may be set forth as follows :—

[A], Schools for Higher Technical Education ; [B], Schools for Secondary Technical Education ; [C], Schools for Primary Technical Education.

The last may be divided into the following subsidiary types, viz. :—

(1) Primary-technical schools ; (2) Ordinary trade-schools ; (3) Primary arts and crafts schools ; (4) Apprentice schools of the arts and crafts ; (5) Industrial schools with various programmes.

During the last decade these various types of schools have been rapidly multiplied, and will ultimately greatly strengthen the industrial power of Russia. Public spirited men have given large sums of money for the creation of technical schools.[1] The

[1] For educational purposes, the following generous donations have been made, viz. :—Th. V. Tchigeoff, railway contractor, 5,000,000 roubles (£545,000) for five industrial schools, and, later, £15,000 for tools. N. P. Trapeznikoff, gold-mine proprietor, 3,000,000 roubles (£327,000) for industrial instruction in Irkutsk. A Councillor of Commerce, Komaroff, established a primary technical school at Rybinsk, a town of, say, 30,000 inhabitants. A merchant, Pastoukhoff, put up a building worth £21,800, and gave for its maintenance a further sum of £19,600. Prince V. N. Tenicheff created an apprentice school at Briansk. M. Polejaieff, merchant, left a sum of £21,800 for a technical school at Kaliazine. Moscow municipality gave 850,000 roubles (say, £92,700) for an industrial school in that city. The Lodz municipality gave £21,800 ; Odessa, £109,100 ; Saratoff, £10,900 ; Nicolaieff, £10,900 ; and besides these there are a number of lesser donations.
The attitude toward educational institutions is in this respect very similar in the United States and Russia.

The ministerial and municipal authorities are aiming at a very much larger amount of technical education for the future than in the past, and distinct encouragement is being given to the industrial training of women.

3. *Secondary Technical Education.*—On page 310 of the Commissioners' "Secondary Education" Report, the curriculum of the *Lodz School of Industries and Manufactures* is given. This is a school of about 500 pupils, and may be taken as typical of the form of secondary technical education.

The School of Colorists of Ivanovo-Vozniessensk is also a secondary school of industrial chemistry, the teaching dealing largely with the dyeing and printing of cotton fabrics.

The course is four years, and includes :—Organic and inorganic chemistry ; machine construction ; general technology ; technology of cotton dyeing and printing. The laboratory practice includes : Preparation of dye-extracts, of lakes, of mordants ; bleaching, dyeing, printing, and preparation of cotton thread and fabrics.

After their courses are completed, the students spend six months in practical work in factories, and then become officially "special technologists" for cotton dyeing and printing.

4. *Secondary School for Mechanicians, Kostroma.*—One of the schools founded by the philanthropist, Th. W. Tchigeoff, is the Secondary School for Mechanicians, to which is joined also an elementary technical school of chemical industry, the whole being known as the *School of Associated Industries of Kostroma.* The Secondary School was inaugurated in October, 1897, and the course lasts four years. Admission follows on presentation of a Certificate of the 5th Class of a Realschool, or one testifying to an equivalent grade of instruction. The aim of the school is to qualify technicians to become the direct assistants of engineers or directors in industrial enterprises in which mechanics plays a special rôle. The statutes of the school insist on theoretical and practical teaching in electro-technics. The programme is as hereunder :—

Programme of the Secondary School of Mechanicians, Kostroma.

Subjects.	Years, and Hours per Week.				
	I	II	III	IV	Totals.
Religious Instruction	1	1	1	1	4
Mathematics	4	2	...	...	6
Physics	3	3	...	...	6
Applied Electricity	...	...	4	3	7
Chemistry	3	2	...	...	5
Mechanics	5	2	...	...	7
Construction of Machines	...	2	7	...	9
Mechanical Industries	...	2	3	6	11
Chemical Industries	...	...	...	2	2
Constructions	...	3	...	...	3
Geodesy	2	...	...	...	2
Commercial Geography and Political Economy	...	...	1	1	2
Accountancy and Commercial Correspondence	...	...	1	1	2
Legislation	...	...	...	1	1
Graphical Work—					
Geometrical Drawing	6	4	...	...	10
Technical Drawing	...	4	6	8	18
Drawing applied to Construction	...	...	2	...	2
Imitative Drawing	4	2	...	...	6
Practical Work —					
Workshops for Mechanics—	12	12	16	...	40
Electro-technical Workshop	...	...	...	18	18
Chemical Laboratory Work	...	2	...	...	2
Totals	40	41	41	41	163

The practical work consists of carpentry and joinery, forge-work, foundry-work, locksmithing, workshop practice, work in applied electricity, etc. The arrangement of the work is as follows :—

Class I.—First semester : carpentry, etc., pattern-making, foundry-work. Second semester : forge-work.

Class II.—Workshop practice, locksmithing.

Class III.—Use of different machine-tools, lathes, drilling-machines, planing-machine, etc. Erection of such tools.

Class IV.—Setting up tools in a workshop, work with boilers and steam-engines and an electro-technical workshop.

In the 2nd year two hours a week are also spent in the chemical laboratory.

The workshops are very finely fitted up for ordinary wood and metal work, and for electro-technical work. The transmission of energy to the various workshops is carried out by electric current, supplied by a special 50 h.p. machine, producing a three-phase current. The power in the different workshops is as follows :—Forge, 2 h.p. ; foundry, 5 h.p. ; mechanical workshop, 5 h.p. ; locksmithing, lathe shop, etc., 10 h.p. ; pattern-making, etc., 5 h.p. ; electro-technical workshop, 3 h.p. The whole place is electrically lighted.

The school accepts pupils not younger than 15 years of age, but there is no upper limit, and one finds pupils in the school up to perhaps 35 years of age. The pupils work from 8·30 to noon, or till 1·30 p.m., and from 2 or 3 in the afternoon till 6.

The fees are about 30 roubles per annum, roughly, say, £3.

5. *Primary Technical Schools*.—There is a school at Ivanovo-Vozniessensk of the type [C] (1), see section 2 herein. The industry of this town of about 55,000 inhabitants is mainly Indian fabrics. The aim of the instruction is technical and general, as the following programme will shew :—

Technical School of Ivanovo-Vozniessensk, Russia.

Subjects.	Years, and Hours per Week.					
	I	II	III	IV	V	Totals.
Religion ...	2	2	1	1	1	7
Russian ...	4	3	3	...	...	10
History ...	2	2	...	...		4
Geography	2	2	...	...	...	4
Arithmetic	6	4	1	...	...	23
Elementary Algebra	...	2	2	...	...	
Elementary Geometry ...	...	3	3	2	...	
Elementary Physics	...	...	3	4	2	9
Elementary Mechanics ...	...	...	...	4	3	7
Elements and Organs of Machines	...	...	...	3	3	6
Technology of Wood and Metals	..	...	2	2	2	12
Technology of Textile Materials	...	...	2	2	2	
Drawing ...	3	4	4	...	...	11
Industrial Drawing	3	3	4	6	6	22
Workshop Practice	20	20	20	22	29	111
Totals ...	42	45	45	46	48	226

To be admitted, children must be 12 or 13 years of age, and possess the certificate of primary education of a lower school, and have passed an examination in arithmetic, four rules, Russian weights and measures, in Russian fluent reading, dictation. The fee is a little over £1 per annum.

The following is the scheme of practical work in the workshop :—

Class I.—General ideas of carpentry, joinery and wood-turning.

Class II.—Mechanical workshop practice and work in metals.

Class III.—The same, and about thirty days are devoted to moulding and foundry-work. Pupils are then occupied for forty or forty-five days in pattern-making, it being held that their experience in moulding will make them recognise the limitations of patterns for casting.

In Classes IV and V, the pupils return to workshop practice, learn to use larger machine-tools, and to set up the machinery necessary for different crafts. They learn also to make tools, devoting about forty hours also to learning weaving, and sixty hours to forge-work. The weaving work enlightens them upon the knowledge of textile fabrics. Prior to making machines and tools, the pupils make plans of the details.

After having completed their workshop practice, the pupils of the higher classes go for two weeks to some factory in order to perfect themselves, going to see the machine-tools or the drawing-office, according to which is of the greater interest to them. Most of the manufacturers give them a small salary. They also make excursions to various factories, under the care of the professors or director. The articles made in the school are sold ; the work done, therefore, is really practical work.

It is worth noting the pupils belong generally to the poorest portion of the population, and many of the families cannot afford to maintain their children during the five years' studies, but the merchants in the town have established a fund of about £1,100, the interest of which is given to the poorest pupils, so as to enable them to maintain themselves.

6. *Trade-School of Makarieff, Russia.*—The Trade-School of Makarieff is of the type [C] (2), see section 2. It has a preparatory class, and the three classes indicated in the programme hereunder. The object of its instructional courses is to initiate the pupils into the general work of carpentry and joinery, locksmithing, forge-work, pattern-making, and the erection of machinery. In addition to the purely practical part of the instruction in the workshops, certain branches of the teaching have for their object the continuation of that theoretical knowledge indispensable to intelligent workmen. Candidates for the first year must shew that they have followed the course of instruction in a primary or parish school, or in a rural school of one class, or of that of a municipal school. The preparatory class has a programme including religious instruction, Russian, arithmetic, geometry, history, geography, caligraphy, imitative and geometrical drawing, joinery, locksmithing. The practical work in the course consists of locksmithing, forge-work, carpentry, pattern-making, moulding, and foundry-work.

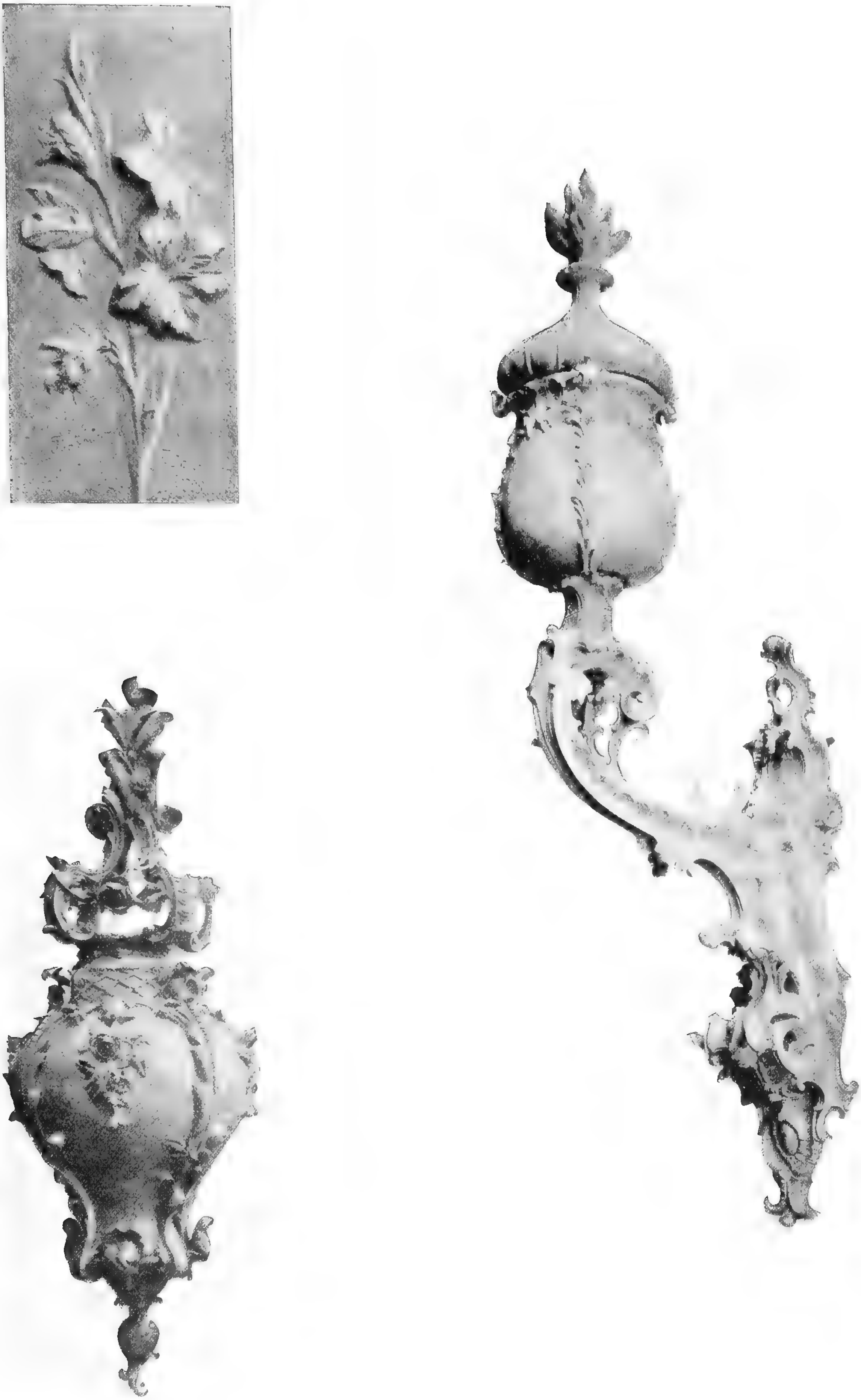
The age of the pupils is usually between 12 and 21 years. The fees are only 3 roubles per annum (roughly 6s.), and poor pupils are relieved of all payment. Those who wish to live at the school pay 97 roubles per annum (roughly about £10 10s.) For this they receive board and sleeping accommodation.

Work commences at 8·30 and lasts till noon for the theoretical part. Four hours in the afternoon are devoted to practical work in the workshops ; three hours in the evening are devoted to study of lessons for the next day or general reading, a school library furnishing the necessary books. About £110 per year are devoted to small bursaries.

The feature of general schooling in the morning and workshop practice in the afternoon is a very common one in Russia.

The

WORK SEEN IN A SCHOOL OF INDUSTRY IN ST. PETERSBURG.



WORK SEEN IN A SCHOOL OF INDUSTRY IN ST. PETERSBURG.

WORK SEEN IN A SCHOOL OF INDUSTRY IN ST. PETERSBURG.

CHAPTER XXVIII.

CHAPTER XVIII.

Trade Schools of America.

[J. W. TURNER.]

Introduction.—The Trade School in America is of comparatively recent growth, and, while subsidised to some extent by the State Governments and Municipal Councils, is generally the outcome of private benefactions.

In the Eastern States special schools have been established in connection with the textile industry, and instruction is given in the theory and practice of cotton manufacture, the construction and operation of the machinery, and the artistic principles involved in the production of desirable and ornamental fabrics. The practical portion of the instruction is gained in local factories.

Other special schools in these States are intended for the benefit of artisans needing instruction in painting, drawing, modelling, and designing. In maritime cities, naval architecture is added to the curriculum.

New York has a trade school, liberally endowed by private philanthrophy, with an attendance of 600 pupils and a staff of thirty instructors. The day-classes include plumbing, house and fresco painting, sign painting, sheet-metal cornice work, bricklaying, plastering, carpentering, steam and hot-water fitting, and electrical work. A nominal fee is charged for the tuition, and on the satisfactory completion of the course a diploma is issued.

San Francisco has two splendid trade schools, endowed by private enterprise.

The essential difference between the German continuation schools and these later developments in America may be indicated thus: The German lad learns the practical part of his trade from the employer to whom he is apprenticed, and supplements this instruction at a continuation school, which he must attend, in some parts of the country, till he is 18 years of age (*vide* Chapter on Trade Schools in Germany); the American lad attending a trade school acquires the whole of his trade, both theoretical and practical, from competent instructors inside the school.

The organisation and syllabus of the two trade schools of San Francisco as set out in Circulars 7 and 3, June, 1902, are given in full.

The Californian School of Mechanical Arts.

History.

This institution is the gift of James Lick, a citizen of California. Circular No. 7, issued by the Board of Trustees, states that, "having been brought up in narrow circumstances, earning his living in early manhood as a mechanic, he sympathised with the struggles of the young for a place in life, and resolved to found a school where those who were dependent upon themselves could receive such an education as would give them a foothold in the world."

In 1875 he executed a deed of trust by which he conveyed to certain trustees a large amount of property for various purposes of public benefit, of which this school was one. Its endowment is provided for in the deed of trust in the following terms:—

> Fourteenth—And in further trust, to found and endow, at a cost of five hundred and forty thousand dollars ($540,000), an institution to be called "The California School of Mechanical Arts," the object and purpose of which shall be to educate males and females in the practical arts of life, such as working in wood, iron, and stone, or any of the metals, and in whatever industry intelligent mechanical skill now is or can hereafter be applied; such institution to be open to all youths born in California.

It was not till twenty years later that, owing to prolonged litigation, the buildings were completed, and the school formally established.

In the year 1900, the Wilmerding School of Industrial Arts, a totally distinct endowment, was opened in the city of San Francisco, on a block of land in close proximity to the Lick School. The management of the two institutions took this step with a view to having the two schools supplement each other, and co-operate as far as possible. Later on the plan of co-operation was still further extended by placing both institutions under one head-master, but still preserving the two distinct trusts in the management. The particular distinction between the two schools is as follows:—

Policy.

The policy of the Lick School is to expand in the direction of the *machinery trades*—Pattern-making, model-making, forge-work, moulding, machine-shop practice, electrical construction, machinery and ship-drawing.

The curriculum of the Wilmerding School includes a long list of *building trades*—Carpentry, bricklaying, plumbing, architectural ironwork, clay-modelling, artificial stonework, wood-carving, cabinet-making, architectural drawing.

Condition of Admission.

The school is free of charge for tuition, and is open to any boy or girl of the State of California, who has completed the eighth grade of the grammar schools. Places for boys are apportioned among the fifty-seven counties of the State, according to population. The city of San Francisco had twenty-four new places in the 1902 session, Los Angeles, eleven. Qualified applicants are admitted upon the recommendation of the principal of a grammar school or the school superintendent. For all places not filled by recommendation a competitive examination is held. This examination is written, and the applicant's qualifications are judged in English composition, arithmetic, United States history, descriptive geography. Qualified female applicants are also admitted upon recommendation, but the numbers are considerably less than the boys. Those entering from High Schools are required to give proof of their standing in English, history, algebra, geometry, physics, chemistry, drawing, shopwork.

Expenses.

There is no charge for tuition, but students are required to furnish their own books, drawing instruments, overalls, aprons, and edge tools, and to pay the actual cost of working materials. The total expense averages about twenty dollars a year for boys, and about fifteen dollars a year for girls. In the department of forging each student must provide himself with three pairs of tongs and a hammer, at a cost of two dollars for the entire set. Each boy entering the machine shop must provide himself with two pairs of calipers and a steel try-square. The following is a statement of the cost of books, as required at the beginning of the school year 1902–1903 :—

Books—	
Well's Essentials of Algebra	$1 00
Scott and Denny's Elementary English Composition	85
Physical Laboratory Manual	50
General Note Book	25
Tools and Instruments—	
Set of Woodworking Tools	$2 75
Note Book for Woodwork	35
Apron and Blouse	60
Set of Drawing Instruments	Boys, $5 00 to 7 50
Pair of Triangles	35
Materials—	
Lumber, Iron, Chemicals, Drawing Materials, Sewing Materials, etc., supplied as needed for half year	$5 00

A set of chisels and plane-blades for wood-working will cost two dollars and seventy-five cents. They are required of all boys at the beginning of the first year, and are as follows : Buck's or Barton's bevelled-edge socket firmer chisels, ¼-inch, ¾-inch, and 1¼-inch ; plane-irons for Bailey's iron planes, No. 5, No. 6, and No. 9¾ ; Russell Jennings's auger bit, ⅜-inch ; Webster's shoe-knife, No. 2 ; 2-foot rule.

All other tools and appliances are furnished by the school, and loss or breakage, resulting from carelessness, is charged to the pupil responsible for such damage.

The work of keeping in order the buildings, grounds, apparatus, tools, and machinery affords opportunities for students to earn a small amount by working before and after school hours, and during vacations. To those who cannot afford to purchase all the books, instruments, and tools required, the school will undertake to lend a reasonable portion of the things needed, upon written request of parent or guardian.

Buildings.

There two main buildings—the academic building and the shops. The former contains four lecture-rooms, physical and chemical laboratories, drawing-rooms, and the domestic departments. The academic building is of three stories. In the basement all the walls and partitions are made of artificial stone, cast *in situ*, and the floors are entirely of concrete. The chemical laboratory and the room for cookery are made fireproof. Every room of the building is provided with means of lighting by both gas and electricity. The plumbing is all exposed, and thoroughly sanitary. The ventilation is accomplished through the agency of the hollow brick-walls, supplemented by a number of large air-shafts leading to the attic, and by registers placed beneath the windows to supply fresh air. Heat is provided by direct radiation from steam-pipes placed around the window sides of each room, fed from the engine exhaust and from the boiler in the shops.

The shop building is made up of a two-story portion, 107 x 40 feet, a one-story portion, 50 x 155 feet, and a cupola-shed—a structure built entirely of iron. The new blacksmith shop and foundry and the shop for electrical construction, shown on the first-floor plan of the shop building, are part of a scheme of enlargement contemplated for both buildings.

Calendar.

The school year begins at the end of July, and consists of two terms of twenty weeks each, divided as follows :—

First Term.	No. Weeks.
Opening week	1
Half term	10
Fall recess	1
Half term	10
Christmas vacation	2

Second Term.	No. Weeks.
Half term	10
Spring recess	1
Half term	10
Closing week	1
Summer vacation	6

Daily Programme.

Hours of attendance during first two years of course	9 a.m. to 3·25 p.m.
" " second "	9 a.m to 4·20 p.m.

The time from 9 a.m. to 3·25 p.m. is divided into seven periods of about 50 minutes each for work of some kind, and for the intervals necessary for rest. The amount of prescribed home-work is reduced to a minimum, but at least one and a half hour's home study daily, free from disturbing influences, is expected.

Plan

Plan of Instruction.

In formulating the general plan of instruction for the "James Lick" School, the Trustees gave a broad interpretation to the objects and purpose of the founder's bequest. In the light of this interpretation they determined that the school should not be merely a number of workshops, not a place to perpetuate the routine and drudgery of shop-life, but an institution to promote "intelligent mechanical skill."

In order to carry out the provisions of the endowment, as thus interpreted, a careful survey was made of the entire field of industrial education, with a view to selecting such features as could best be adopted to the special needs of the State and incorporated in a scheme of instruction that would accomplish the following specific ends:—

First.—To give each student a thorough knowledge of the technique of some one industrial pursuit from which he may earn a living.

Second.—At the same time, to see that his acquaintance with tools and materials, and with science and art, is broad enough to allow the fullest development in his especial field and to permit of his ready adjustment to the new and varying conditions that are constantly taking place in all the mechanical and industrial arts.

Third.—To develop in him a degree of intelligence that will fit him for the duties of active citizenship.

The school has two correlated lines of instruction—(*a*) The Preliminary Manual Training Course; (*b*) the Technical Courses.

The student begins with a Preliminary Manual Training Course of about two years, and when he has nearly completed it, he is allowed to select one of thirteen mechanical and industrial arts, known as Technical Courses, so that he may devote to his chosen field of work his entire time for two years, thus making the course about four years in all.

There is a marked difference between the plan of instruction in the James Lick School and that of the Manual Training Schools already described. In the latter the courses are usually of three years duration, in the James Lick the courses are of four years. In the Manual Training Schools the courses are chiefly valued for their educational worth, and the question as to the particular pursuit a student is going to follow receives no consideration until after graduation, that is on the completion of the courses. In the James Lick School the first care is to cultivate in the pupil power and judgment, good tastes, and correct habits of thought and action. Little by little this educational process gives way to the consideration that social conditions require that every member of the community, if he is to be successful, must know thoroughly some one thing, and the ultimate object of the courses is to afford each student an opportunity to acquaint himself with all that pertains to one of several of the most important industrial pursuits. In other words, the Trustees claim that the plan of instruction begins with the educational or æsthetic side and ends with the practical or labour side.

The Preliminary Course does not end abruptly at the close of the second year, but merges into the apprentice courses for about six months. At the beginning of the third year any student who has completed the first two years of the Preliminary Course with satisfactory standing may elect one of the Trades or Technical Courses, pursuing therein a formal apprenticeship of two years, leading to a diploma of graduation; or, those who do not desire to pursue any of the apprentice courses offered will have the privilege of attending during the third year with the view to receiving a certificate for the completion of the Preliminary Course.

Preliminary Course.

The Preliminary Course serves as a foundation for the different Trades and Technical Courses. This part of the curriculum is essentially the same as the course given in the so-called manual training schools. It is different for boys and girls as regards toolwork and domestic branches, but otherwise it is the same for all the students, and is required of all. It divides its time equally between academic and industrial branches.

The Academic Branches include English, mathematics, science, and history. One period of fifty minutes per day, for two years, is devoted to each of these subjects, with the exception of History, which is given on alternate days.

The instruction in English includes word study, grammar, and rhetoric, practice in written and oral expression, and a study of literature through English classics.

The mathematical instruction includes elementary algebra, plane, solid, and spherical geometry, and plane trigonometry.

The science work consists of physics (except sound and light) during the first year; chemistry during the second year; and physics (sound and light) during the first quarter of the third year.

The preliminary instruction includes, also, a general course of ancient, medieval, and modern history.

The Industrial Branches are made up of the three elements: Toolwork; Freehand and Mechanical Drawing; and Household Art and Science.

The Toolwork is for boys only. During the first year it consists of a graded course of manual training woodwork, including instruction in the growth of woods and manufacture of lumber, sharpening saws and edge tools, elementary joinery, lathework, notes and drawings of all work performed, foundry practice, and pattern making. Forgework and moulding are given during the second year, machine-shop practice, including both benchwork and lathework, during the third year.

The work in Household Art and Science begins in the first year with a course of plain sewing and the preliminary parts of cutting and fitting. Drafting and dressmaking proper are completed during the first term of the second year. The rest of the second year is used for millinery. The third year's work of this department comprises cooking; a comprehensive course in the direct application of science and art in the household (including interior decorations and furnishing, heating, lighting, ventilating, and other sanitary conditions, and hygiene); and a course of chemistry (including chemistry of foods, sanitary chemistry, chemistry of cleaning, chemistry of dyestuffs, and use of microscope).

Synopsis

Synopsis of Preliminary Course.

First Year.

Boys and Girls.	No. Weeks.	Periods. per week.
English	40	5
Mathematics (Algebra)	40	5
Science (Physics)	40	5
History (Ancient)	40	2½
Boys.		
General Woodwork, Moulding and Pattern-making	40	10
Freehand and Mechanical Drawing	40	5
Girls.		
Sewing	40	7½
Freehand and Mechanical Drawing	40	5

Second Year.

Boys and Girls.	No. Weeks.	Periods. per week.
English	40	5
Mathematics (Geometry)	40	
Science (Chemistry)	40	5
History (Medieval and Modern)	40	2½
Boys.		
Forgework and Moulding	40	10
Freehand and Mechanical Drawing	40	7
Modelling and Wood-carving*		
Girls.		
Dressmaking and Millinery	40	7½
Freehand and Mechanical Drawing	40	5
Modelling and Wood-carving*		

Third Year.

Boys.	No. Weeks.	Periods. per week.
Mathematics (Logarithms and Trigonometry)	10	5
Science (Sound and Light)	10	5
U. S. History and Government	20	5
Machine-shop	20 to 40	10
Girls.		
Science (Sound and Light)	10	5
German (Elective)	40	5
Cookery	40	10
Household Art and Science ; Chemistry of Cooking	40	5
Modelling and Wood-carving*		

* Modelling and Wood-carving are optional. Students go to Wilmerding School building for these subjects.

Trades and Technical Courses.

The school has facilities for teaching the following trades and technical courses, from which each student is allowed to make a selection at the beginning of his third year :—

1. Pattern-making.
2. Forgework.
3. Moulding.
4. Machine-shop Practice.
5. Machine and Ship Drawing.
6. Industrial Chemistry.
7. Industrial Art.
8. Cookery.
9. Dressmaking.
10. Millinery.
11. Preparatory for Technical College Course.

Through these courses the school aims to give each student a thorough knowledge of the technique of some one industrial pursuit, from which he may earn his living. It offers, however, something more than the mere equivalent of a workshop apprenticeship.

1. Before commencing work exclusively at his trade, each student must first complete a preliminary course of woodwork and ironwork, including the elements of joinery, pattern-making, forging, moulding, and iron fitting

2. The Preliminary Course includes, also, systematic instruction in English, history, mathematics, science, and drawing ; and even during the last two years science and mathematics are studied to some extent, to supplement the purely apprenticeship training.

3. There is the additional advantage that the shop instruction throughout is based upon work that is selected, as far as possible, for the benefit of the student, and not for the profit of his employer. Yet, a reasonable proportion of each student's time is devoted to the manufacture of marketable goods, in order that he may be made to realise the conditions that he will have to face in after life. Before leaving the school he must be able to execute his work in such a manner and at such a rate that the product of his labour, if placed upon the market, will stand the test of competition.

About 75 per cent. of the time of each apprentice course is devoted to Technical Instruction, and the remaining time to supplementary instruction.

In Mathematics and Science all apprentices take one or more of the following, as explained under each apprentice course :—

1. Theoretical mechanics.
2. Strength of materials, including laboratory practice and tests.
3. Determination of stresses in framed structures by graphical and analytical methods.
4. Heat calculations and phenomena of combustion, including a general study of transformations of energy ; hydrostatics ; laws of gases ; computations for electrical transmission, etc.
5. Simple boiler and engine tests ; dynamo tests.
6. Metallurgy of iron.
7. Book-keeping and business forms.

The

The school is not in any sense an engineering institution; on the contrary, its aim is to keep the grade of academic instruction down to the plane of the best high schools. In shop lines attention is devoted to the practical construction of machinery. The instruction given in certain branches of applied mathematics and science while very helpful to young men about to enter upon industrial careers, is not sufficient to constitute an engineering course.

All apprentices are given a brief course in Political Economy, Commercial Geography, and the History and Government of the United States.

All apprentices are required to meet one hour per week, either in a body or in sections, for the purpose of discussing papers and reports to be submitted by individual members, somewhat after the seminary plan. The subjects of these reports are selected or assigned by the pupils themselves, as far as possible, and relate to manufacturing processes and devices, to topics from the history of art and industry, and to scientific subjects. Each report must be exhaustive, and is placed before the class as clearly as possible by means of printed abstracts and the stereopticon, the presentation to be followed by a thorough discussion.

The Free Public Library affords excellent opportunities for outside reading and study, and is well patronised by members of the school. In addition to a large and well-selected list of books on practical and technical subjects, it has also most of the leading scientific and technical periodicals.

I.—Apprentice Course of Pattern-making—

Technical Instruction.

Continuous practice upon patterns for actual use in the foundry, including gear wheels, steam pumps, engines, hoists, propeller blades, dynamo frames, etc.; corework and sweepwork; model-making.

Supplementary Instruction.

Study of advanced foundry work.
Methods of manufacturing, preserving, and seasoning lumber.
Shop arrangement and management.
Woodworking machinery and mill methods.
Methods of storing and checking patterns.
Mechanical drawing.
Science and mathematics.

II.—Apprentice Course of Forgework—

Technical Instruction.

Continuous practice in forging difficult machine parts, such as engine shafts, connecting rods, and other parts; accessories for hoists; cranes; forge tools; lathe tools; carriage and waggon parts, etc. Also, structural and ornamental ironwork, and sundry selected jobs covering the entire field of forging.

Supplementary Instruction.

Estimates, contracts, and specifications.
Properties, sources, and prices of materials used.
Metallurgy of iron; production of steel; manufacture of rolled steel shapes, and their uses.
Science and mathematics.
Saturday excursions to ironworking establishments.

III.—Apprentice Course of Moulding—

Technical Instruction.

Standard foundry practice in all its details. The articles of machinery manufactured at the school are both numerous and varied, requiring many castings in iron, brass and other metals, and affording ample exercises in moulding. Practice is also had in casting bronze figures, in piece moulding, moulding in gelatine, wax, and sulphur, and by the lost wax process for undercut work. Corework, sweepwork, care of cupola, etc.

Supplementary Instruction.

Estimates, contracts, and specifications.
Metallurgy of iron.
Science and mathematics.
Saturday excursions to ironworking establishments.

IV.—Apprentice Course in Machine Shop—

Technical Instruction.

Machine-shop practice in all its details, requiring work at the vice, and including the use of the lathe, planer, shaper, milling machine, drill press, etc. Construction of engines, hoists, lathes, pumps, etc. Electrical construction—dynamos, motors, hoists, heating and lighting appliances, etc. Care of power plant.

Supplementary Instruction.

Estimates, contracts, and specifications.
Prices, sources, and properties of materials used.
Metallurgy of iron and production of steel.
Science and mathematics.
Saturday excursions to ironworking establishments.

V.—Apprentice Course in Mechanical Drawing—

Technical Instruction.

Machine Drawing.—Drawing familiar machine parts to scale. Design of gear teeth, with application to rack and pinion, spur, bevel, helical, and worm gears. Sketching to measurement a machine, involving gearing, and making the complete working drawings for shop use. Drawing and detailing pumps, compressors, hoists, water-wheels, oil-burners, gas and oil engines, electric motors, and dynamos; boiler

boiler settings and auxiliary connections for complete steam plant. Use of rolled steel shapes and calculations of columns, beams, and shafts. A study of valve diagrams. Engine and boiler designs—land and marine. The design of engine valves, link motions, governors, and fly-wheels. A consideration of various types of engines and boilers.

Ship Drawing.—In this course the "lines" of a ship's body, the midship section, inboard and outboard profiles, are drawn to a suitable scale, and a wooden model is made in order to give the student a clear conception of the actual form represented by his lines. The stability, carrying capacity, and displacement in tons are calculated from the drawings. Practice is given in the use of the Rules of the Classification Societies, such as Lloyds, Bureau Veritas, and American Bureau of Shipping. Practical points of ship construction are dealt with and the apprentice is given as much familiarity as possible with shipyard methods.

Tracing and blueprinting throughout the course.

Supplementary Instruction.

Estimates, contracts, and specifications.
Metallurgy of iron and the production of steel.
Science and mathematics.
Saturday excursions.

VI.—Apprentice Course of Industrial Chemistry—

This course is intended to meet the demand for workmen skilled in the use of chemical tools and appliances; it is not in any sense the equivalent of college courses of chemistry for the education of scientific investigators. It aims to give the student a thorough knowledge of chemistry as applied to industries based upon chemical principles. The course includes qualitative and quantative analysis, as applied to the analysis of sugars, wines, soaps, acids, paints, fertilisers, and other commercial products and by-products.

Supplementary Instruction.

Science and mathematics.
Saturday excursions.

VII.—Technical Course of Industrial Art—

This course is necessarily restricted by the lack of facilities at the school for *executing* designs for oilcloths, fabrics, stained glass, wall-paper, mural decorations, etc., but this defect is corrected as far as possible, by frequent visits to factories and by inquiries among manufacturers. Since the school itself has facilities for executing designs in wood, clay, terra-cotta, and iron, the fundamental principles are especially applied to work done in those materials. In addition to the elementary principles of perspective, light and shade, colour, etc., studied during the preliminary course, the following topics will suggest the field of work in this course:—

History of Art.
Drawings of the Five Orders.
Anatomy.
Plant analysis.
Copying of ornaments from casts, photographs, and natural objects.
Laws of composition and their application.
Designs for furniture, ornamental iron, pottery, &c.
Excursions to museums, art exhibitions, etc.
Chemistry of materials used—their properties, preparation, etc.

VIII.—Technical Course of Cookery—

A continuation of the third year's course of cooking from a more scientific standpoint.
More advanced processes, as canning, preserving, pickling, desserts, ice-creams, &c.
Cooking for invalids.
Physiological considerations and nutritive values.
Preparation of menus.
Table decorations.

IX.—Technical Course of Dressmaking—

Designing and manufacture of tea-gowns, princess dresses, tailor-finished suits, jackets, children's garments, etc.
History of costume.
Study of drapery.
Sketching.
Hygienic principles.
Methods of manufacturing threads, cloths, and other materials used.
Excursions to manufactories.

X.—Technical Course of Millinery—

Covered hats and bonnets, crepe bonnets, shirred and velvet hats, etc.; manufacture of frames and braids; trimming with choice materials.
History of costume.
Sketching.
Methods of manufacturing materials used.

XI.

XI.—Preparatory for Technical College Course—

Graduates from this course are fitted to enter the Universities in the courses of civil, mechanical, electrical, and mining engineering, with preparation in the following subjects, as enumerated in the list of requirements for admission to the University of California (p. 5 of the University Register for 1901-2): A. Oral and Written Expression; 1. English; 3. Algebra; 4. Plane Geometry; 5. Civil Government and American History; 11. Physics; 12, a, Solid Geometry and Plane Trigonometry; 12, b, Chemistry; 14. English; 16. Freehand Drawing.

For 1901-2 the school is accredited in all these subjects.

Subject 17, Mechanical Drawing, is a new requirement, for which a definite allowance of one unit will begin in 1902-3. The various lines of shopwork have not received definite allowance by the University of California, but they are rated by the Leland Stanford Jr. University as follows:—Woodwork, ½ unit; Forgework, ½ unit; Foundry work, ½ unit; Machine-shop work, 1 unit.

Beginning July, 1902, all students in this course will be required to take German five times a week for two years, to meet the modern language requirement of the University of California, announced for 1905.

The Staff.

The Staff consists of the Principal, who takes the Theoretical Mechanics; a Vice-principal. Mathematics; a lecturer in English (a lady teacher); a lecturer in History and Government (a lady teacher); a lecturer in Physics (a lady teacher); a lecturer in Chemistry; a lecturer in German; two teachers of Freehand Drawing (both lady teachers); a teacher in Mechanical and Architectural Drawing; a teacher in Mechanical and Ship Drawing; a teacher in Modelling and Architectural Ornament; a teacher of Sewing, Millinery, and Cookery; a teacher of Pattern-making; an assistant teacher in General Woodwork; a teacher of Forgework and Moulding; a teacher of Machine-shop Practice; a recorder; an engineer.

Attendance.

The attendance at the James Lick School approaches 400, in the proportion about of 3 boys to 1 girl.

The Wilmerding School of Industrial Arts, San Francisco.

Introduction.—The Wilmerding School of Industrial Arts for boys was founded by J. C. Wilmerding, in the beginning of the year 1901, and the Regents of the University of California are the governing body. In his will he provided for the endowment of this institution in the following terms:—

"I give, devise, and bequeath to the Regents of the University of California, the sum of four hundred thousand (400,000) dollars, upon the following trusts and conditions, to wit:—

"To establish and maintain a school to be called 'The Wilmerding School of Industrial Arts,' to teach boys trades, fitting them to make a living with their hands, with little study and plenty of work.

"Said Regents are empowered to purchase lands, and erect thereon suitable workshops and places of instruction, and to equip the same with such machinery, tools, and implements as in their judgment may be necessary and proper; but I suggest to them that the expenditure for the purchase of said lands, and the construction and equipment of said workshops and places of instruction, be kept within such bounds as that portion of said four hundred thousand (400,000) dollars thereafter remaining shall be able to produce an income sufficient to forever maintain and support said school."

The Regents of the University decided to place the buildings in the neighbourhood of the Lick School, in order that the efficiency and usefulness of both endowments might be enhanced by a plan of co-operation. The Lick School having made provision for a series of machinery trades, it seemed advisable for the Wilmerding School to devote its efforts more particularly to the building trades.

Purpose of the School.

In Circular No. 3 issued by the Trustees it is stated:—"That the school is open to any earnest, industrious boy who wants to learn one of the building trades, as an integral part of his education and preparation for life. It aims, however, to give something more than the mere equivalent of a workshop apprenticeship. Its graduates must have a fair command of the English language. They must know enough of Mathematics, Drawing, and Science, to ensure intelligent, progressive workmanship, as contrasted with the routine, rule-of-thumb methods so widely in vogue. In general intelligence they must be prepared to enter upon the duties of active, law-abiding citizenship. But, with all these things, the student must acquire a thorough mastery of his trade; he must become a skilful, rapid, and thorough workman. The instructors in charge of the mechanical departments have all been successful foremen in their respective trades, and are fully competent to make and keep the work of the school thoroughly practical. At the same time, the shop exercises are selected and graded, not for the profit of an employer, but with a view to enabling the apprentice to progress as rapidly as possible. As a rule, employers deem it to their advantage to pursue a policy of restriction by keeping a boy on one kind of work as long as possible; it is our policy, and to our advantage, to make the training of our apprentices as broad as may be feasible without sacrificing thoroughness of workmanship. It is not expected that all will become foremen or independent proprietors in after life; but it is not to be questioned that each will have a better prospect because of the advantages afforded by his school-training. Many will reap a degree of independence that they could not have attained under ordinary conditions."

Essential difference in plan of Instruction of the two Schools.

The great point of difference between these two excellent practical schools of San Francisco—the James Lick and the Wilmerding—may be briefly stated as follows:—The plan of the James Lick School, which is controlled by a Board of private citizens, begins with a preliminary manual training course of two years, which serves as a foundation for the different technical courses of two years to follow. The time is divided equally between the academic and industrial branches, and the training, during the first two years, is more educational than utilitarian. The final aim, however, viz., the learning of a trade, is kept well in view, and so the curriculum provides in the first year for a graded course of manual training in woodwork, and in the second year for instruction in the elementary branches of ironwork.

In

In the Wilmerding School, which is controlled by a Committee of the Regents of the Unversity of California, the boy, immediately he enters, begins a training in one of the trades taught in the school The Committee duly points out that the aims of the school are to give something more than the mere equivalent of a workshop apprenticeship,—to ensure progressive workmanship by means of an intelligent training in the English language, Mathematics, Drawing, and Science, to prepare its pupils to enter upon the duties of free citizenship, and in addition to send out into the world students who have acquired a thorough mastery of their trade.

Qualifications for Admission.

Any boy who has completed the Eighth Grade in the Grammar School, about the age of 14, is eligible for admission. Boys who have finished only the Seventh Grade will also be admitted, provided they are over 16 years of age. There are good reasons for granting this concession in the case of the boy who has not completed the full course. Very frequently the new method opens up a new life. Each applicant for admission must present a favorable recommendation from his former teacher, principal, or school superintendent.

Expenses.

There is no charge for tuition, but students are expected to furnish their own books and overalls; and, in the case of apprentices in architectural drawing, drawing instruments. All the materials are furnished by the school, and hence all manufactured articles become the property of the school.

Trades taught.

Upon entering the school each boy begins an apprenticeship in one of the following trades:—

Carpentry.
Plumbing.
Cabinet-making.
Clay Modelling.
Bricklaying.
Blacksmithing.
Wood-carving.

The first year is probationary; at the end of that time any student who has failed to give promise of a successful career in the trade he has chosen will be required to change to another Department; but the school may decline to permit such transfer before the end of the probationary period.

Architectural Drawing.

At the beginning of his second year any student who has shown talent and ability in drawing will be permitted to change to the course of architecture, provided he has also ranked high in the English branches and in mathematics. That is, no student is admitted to an apprenticeship in the architectural department before the end of his first year in the school. He must first enrol in some mechanical trade. This involves no loss of time to the student, for the reason that apprentices in architecture are required to do more or less work in all the various lines of building construction taught in the school.

Graduation.

The successful completion of a full apprenticeship of four years entitles the student to graduate as a journeyman.

Details of Instruction.

The hours of attendance are from 9 a.m. to 12 noon, and from 1 p.m. to 4 p.m. The daily programme includes eight periods of forty-five minutes each. Five periods of each day are spent under instruction in the trade selected by the student, and three periods are devoted to instruction in English branches, mathematics, science, and drawing.

English Branches.—Reading, spelling, composition, penmanship, history, government, and literature are given in a comprehensive course covering a period of three years and divided into six grades of a half-year each, one period a day. The lowest instruction in these branches, or "Grade One," represents an equivalent of similar instruction given in the eighth grade of the grammar school, and is for those boys over 16 years of age who have completed only the seventh gradè. Grammar school graduates begin at "Grade Two," which is equivalent to work given in the junior class of ordinary high schools.

Mathematics and Science.—In this department arithmetic is given as "Grade One" for boys who have finished only the seventh grade of the grammar school. The remaining subjects—elementary algebra; plane geometry; simple experiments in mechanics, heat, electricity, and other parts of elementary physics; simple experiments in chemistry; plane trigonometry; mensuration problems in solid geometry; and theoretical mechanics—are arranged in five grades of six months each, one period a day. The subjects of graphostatics and strength of materials are given to apprentices in architecture during the third and fourth years.

Drawing.—Apprentices in all departments are required to take freehand and mechanical drawing, one period a day, for at least two years. The course of mechanical drawing includes geometric problems, orthographic and isometric projections, development of surfaces, intersections, lettering, shading, simple plans, elevations, and perspectives. The freehand drawing is both representative and decorative, including the drawing of simple objects in outline, light and shade, and historic ornament.

Supplementary Instruction.—During the fourth year, and the latter part of the third—*i.e.*, after completing the several grades of English branches, mathematics, science, and drawing—the student's entire time is under the direction of the instructor with whom he is serving his apprenticeship. The full day may now be spent in the one department; or, in order to meet the special needs or wishes of a student, a part of the day may be used for supplementary instruction in some other line. At this stage, for example, apprentices in wood-carving will do more or less work in the modelling department; apprentices in architecture will need supplementary work in carpentry, bricklaying, plumbing, and other lines; and likewise for other departments, supplementary instruction will be arranged according to the judgment of the teachers and the needs of the student.

Calendar.

Calendar.

First Term.	No. Weeks.	Second Term.	No. Weeks.
Half-term	11	Half-term	10
Fall recess	1	Spring recess...	1
Half-term	10	Half-term	11
Christmas vacation	2	Summer vacation	6

Regulations.— Students must be prompt and regular in attendance. After a period of absence students must present written excuses signed by parents and stating the cause of absence. Appointments with dentists and other private affairs must not be permitted to interfere with their school-work or attendance. As no provision is made for study hours in school, it is necessary for every student to study at home at least one and one-half hour each night five times a week.

Progress of the Institution.

The success of the Wilmerding School of Industrial Arts was very early assured. The first portion of the buildings was ready for occupation in January, 1900; in 1901 additional rooms were started, and in 1903 another portion of the original plans was carried out. A pleasing feature of the material development of this school is that the work of construction—the plans, the excavations, the brickwork, the woodwork, the finishing trades—is almost wholly done by the students of the two schools. A practical proof of the character of the teaching and an object lesson in combined effort came under notice on the occasion of the Commissioner's visit. Most of the building trades, for which the schools are well known, were represented at work on or in connection with the new buildings. In the internal organisation care has been taken by means of solid brick walls and suitable deafening to provide for quiet in the class-room set apart for oral instruction. The class-rooms are so situated that an abundance of light is provided from one side only. The drawing-room is well lighted from the left side only. A part of the carpenter's shop extends through a height of two stories in order that models of houses or pieces of framework built for purposes of instruction may extend to a height of twenty-five or thirty feet, if necessary.

The Staff.

In addition to the Director, who is also Principal of the James Lick School, the staff consists of a Vice-Principal, in charge of the Plumbing Department, a lady teacher in charge of the English branches, teachers for Mathematics and Science, Carpentry, Bricklaying, Forge-work, Cabinet-making, Architectural Drawing, Wood-carving, Clay Modelling and Stone-work, and a Registrar.

Attendance.

The attendance is about 150—all boys.

How the Trades Schools are viewed by the Labour Unions of America.

Mr. Seath, in his very valuable report to his State Government on the question of the introduction of manual training into the high school courses of study, mentions that while the labour unions of the United States look askance upon the trades schools they are invariably favourable to manual training. The N.S.W. Commissioner while in San Francisco was particularly careful in ascertaining the feeling that existed in that city among labour organisations with regard to the plan of instruction adopted by the two independent trusts controlling the two trades schools. In the first place the popularity of the schools is unquestionable. An attendance of nearly 700 amply attests the hold they have upon the people. In the next place the schools have reached the class of students with whom the benefactors were in the truest sympathy. The students of both schools, on the completion of their full course, are rated as tradesmen, and the courteous principal of the schools (George A. Merrill, Esq., B.S.) states that not only is there no friction between the labour unions and the governors, but the former give their support and patronage to the schools.

CALIFORNIA SCHOOL OF MECHANICAL ARTS—FRONT VIEW OF BUILDINGS.

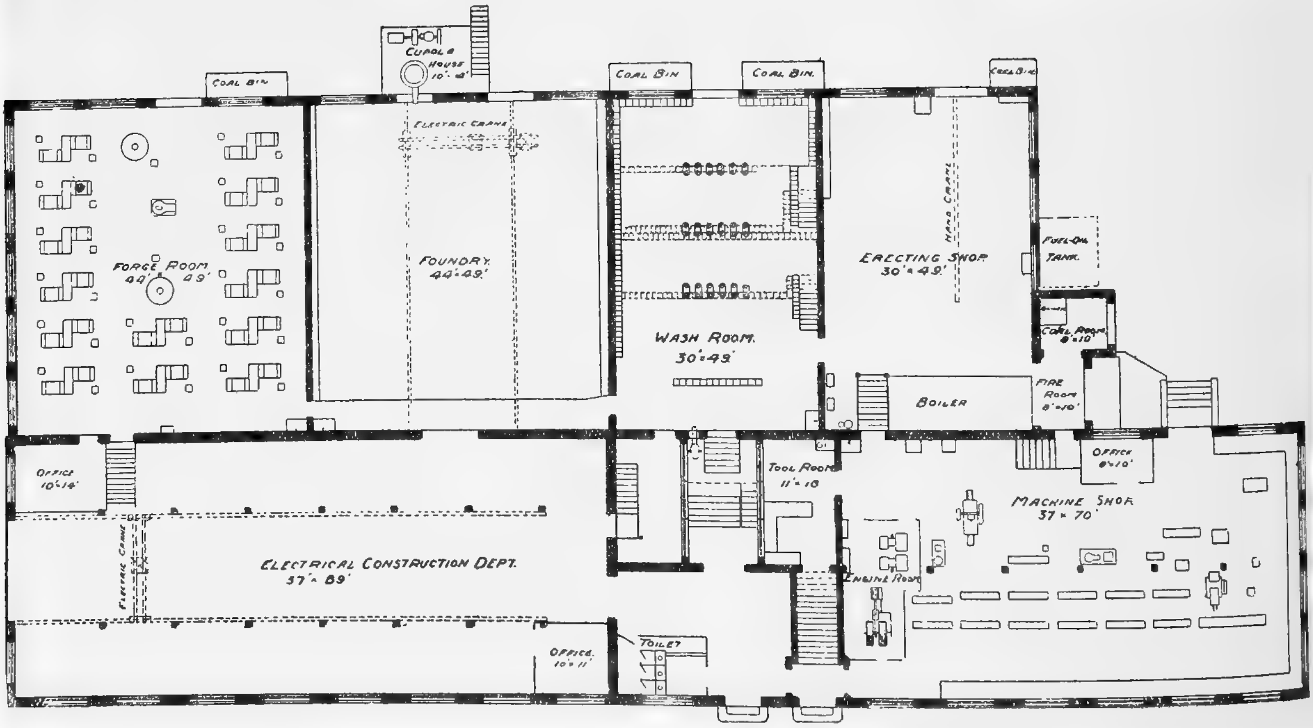


FIG. 4—FIRST FLOOR, SHOPS, CALIFORNIA SCHOOL OF MECHANICAL ARTS.

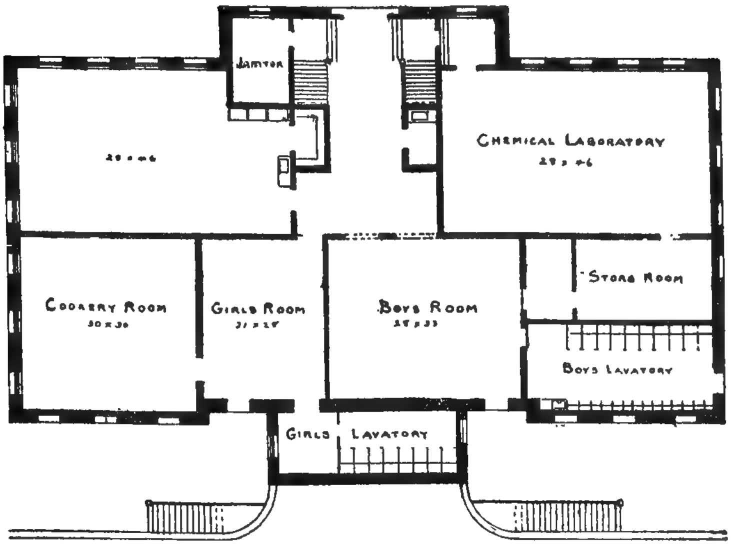


Fig. 1.—FIRST FLOOR, ACADEMIC BUILDING, CALIFORNIA SCHOOL OF MECHANICAL ARTS.

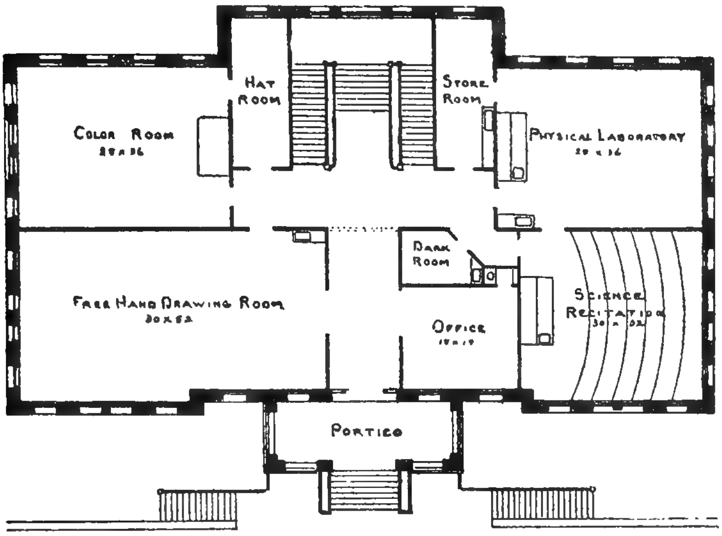


Fig. 2.—SECOND FLOOR, ACADEMIC BUILDING, CALIFORNIA SCHOOL OF MECHANICAL ARTS.

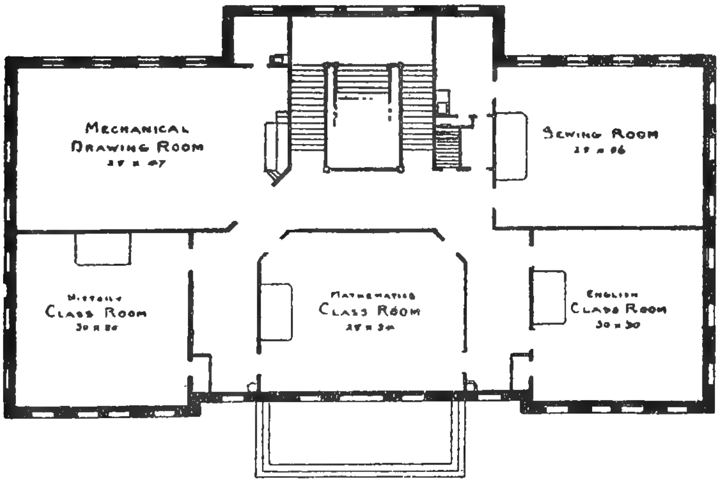


Fig. 3.—THIRD FLOOR, ACADEMIC BUILDING, CALIFORNIA MECHANICAL SCHOOL OF ARTS.

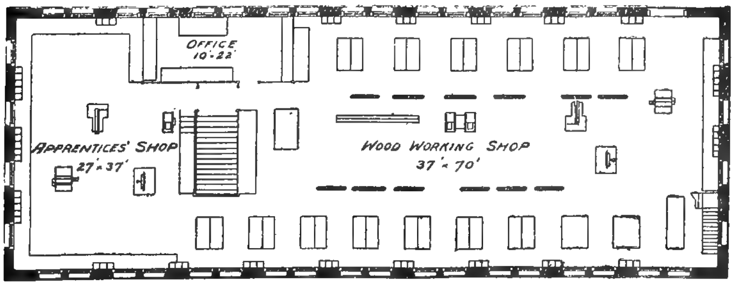
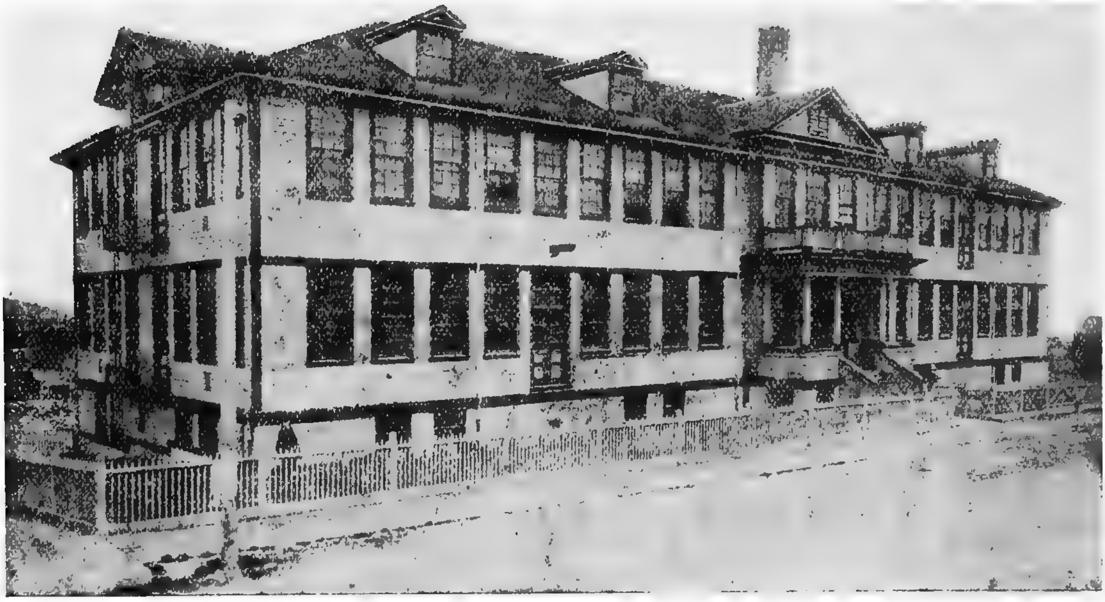
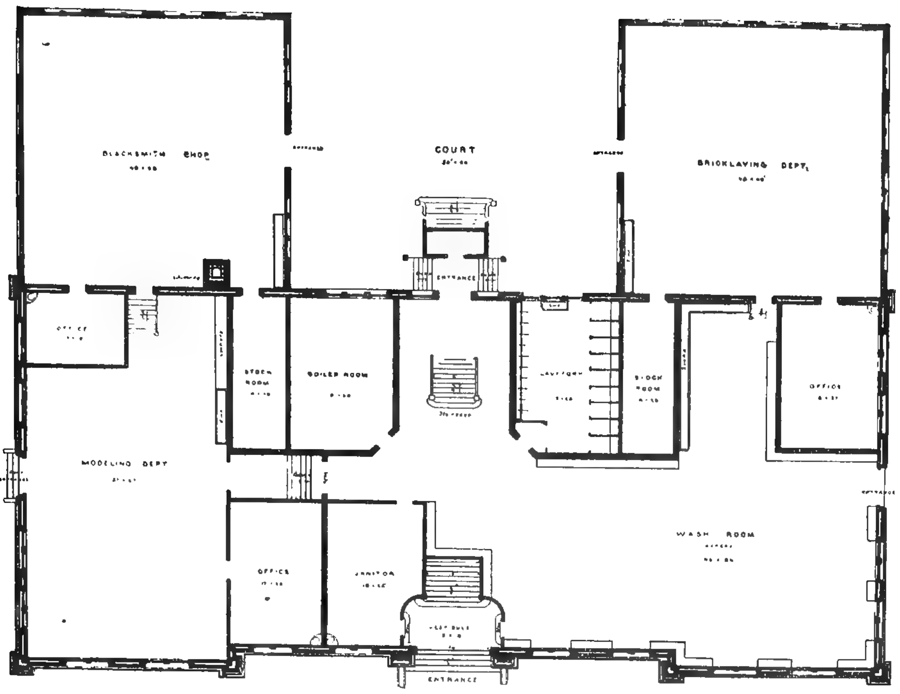


Fig. 5.—SECOND FLOOR, SHOPS, CALIFORNIA MECHANICAL SCHOOL OF ARTS.



WILMERDING SCHOOL BUILDING, SAN FRANCISCO, U.S.A.

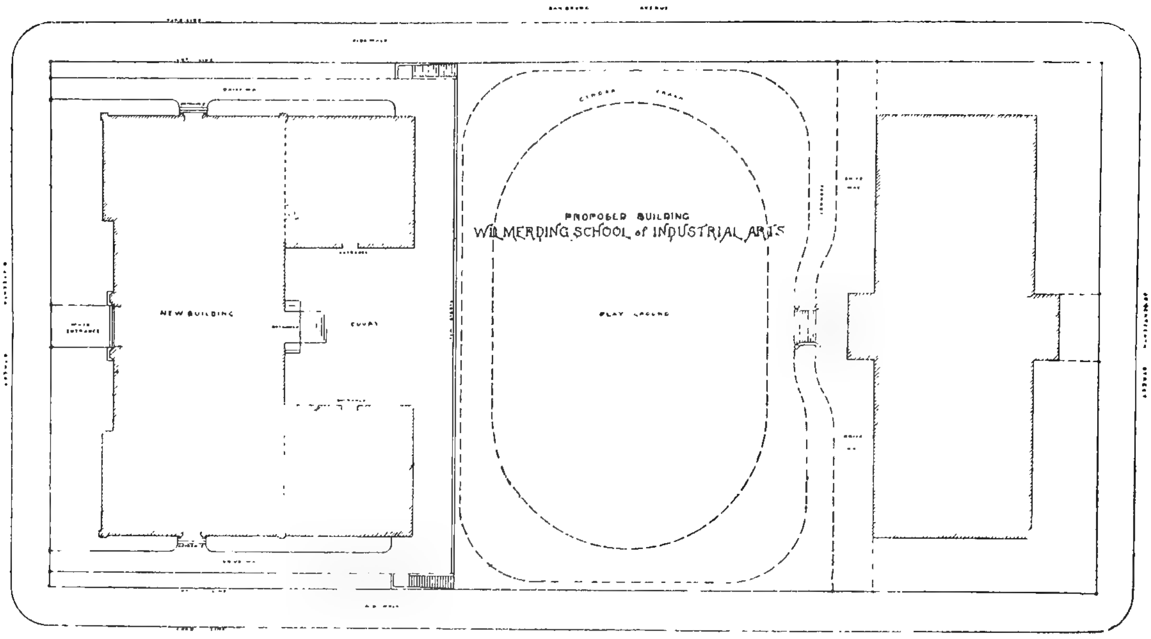
CARPENTER SHOP, WILMERDING SCHOOL OF INDUSTRIAL ARTS.



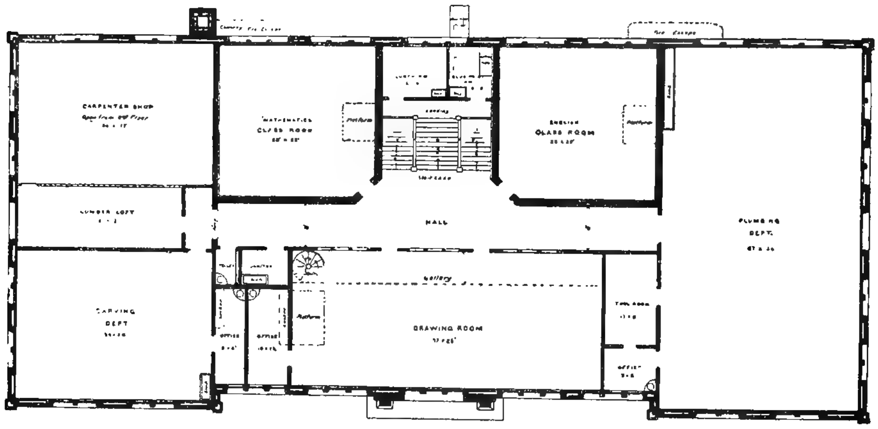
BASEMENT WILMERDING SCHOOL NEW BUILDINGS.

SIDE ELEVATION NEW BUILDINGS, WILMERDING SCHOOL.

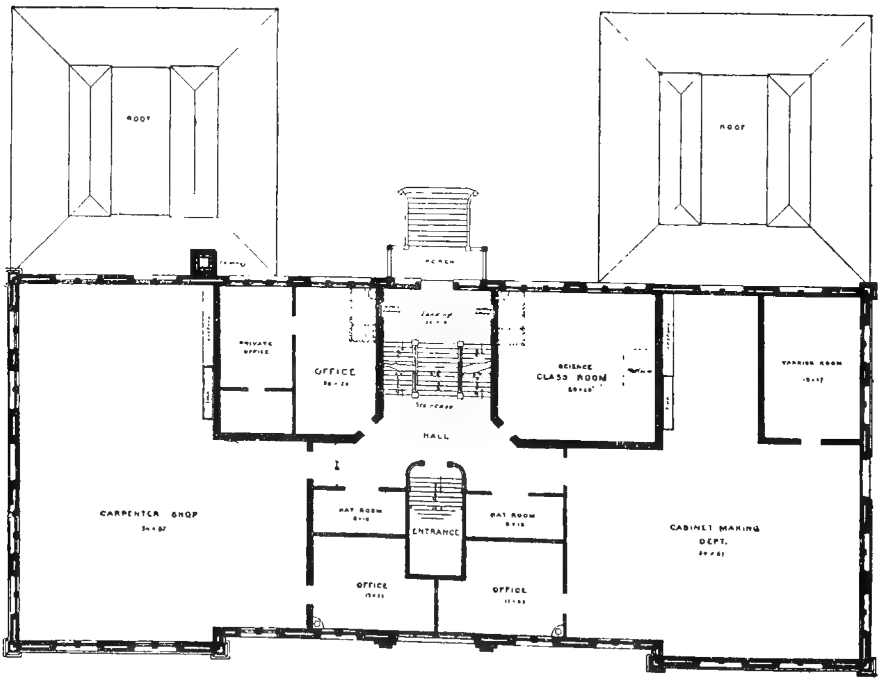
FAÇADE, NEW BUILDINGS, WILMERDING SCHOOL.



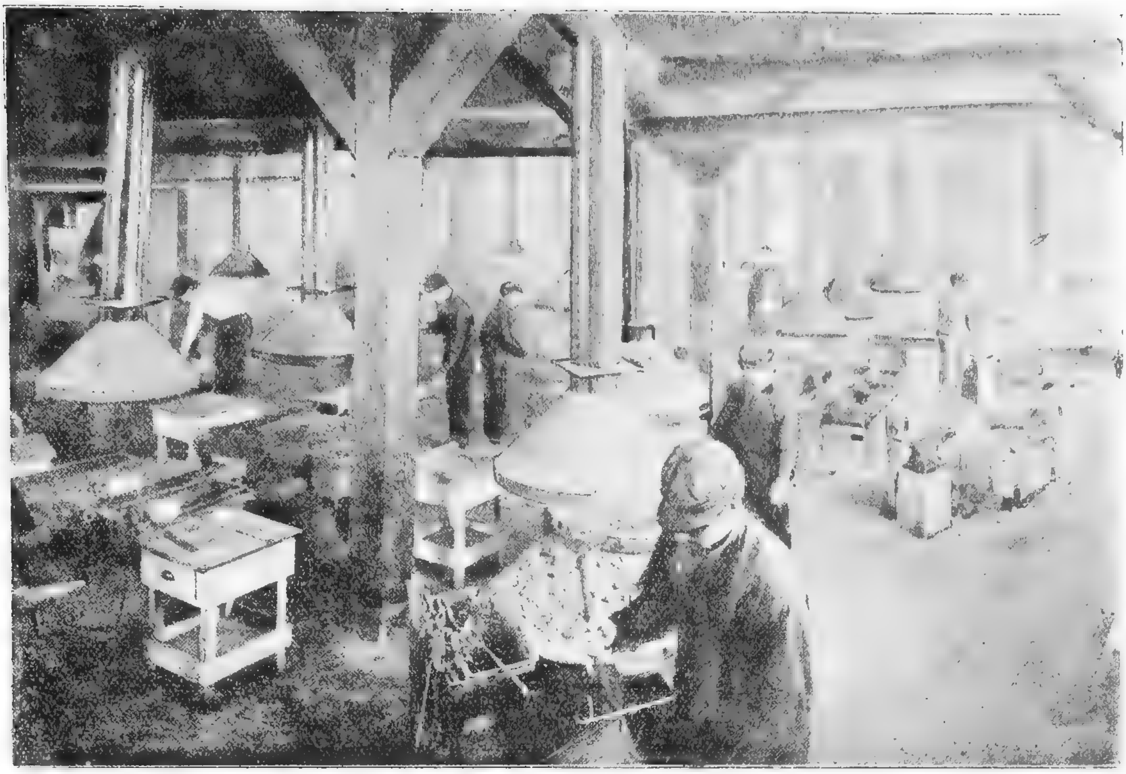
BLOCK PLAN, WILMERDING SCHOOL OF INDUSTRIAL ARTS.



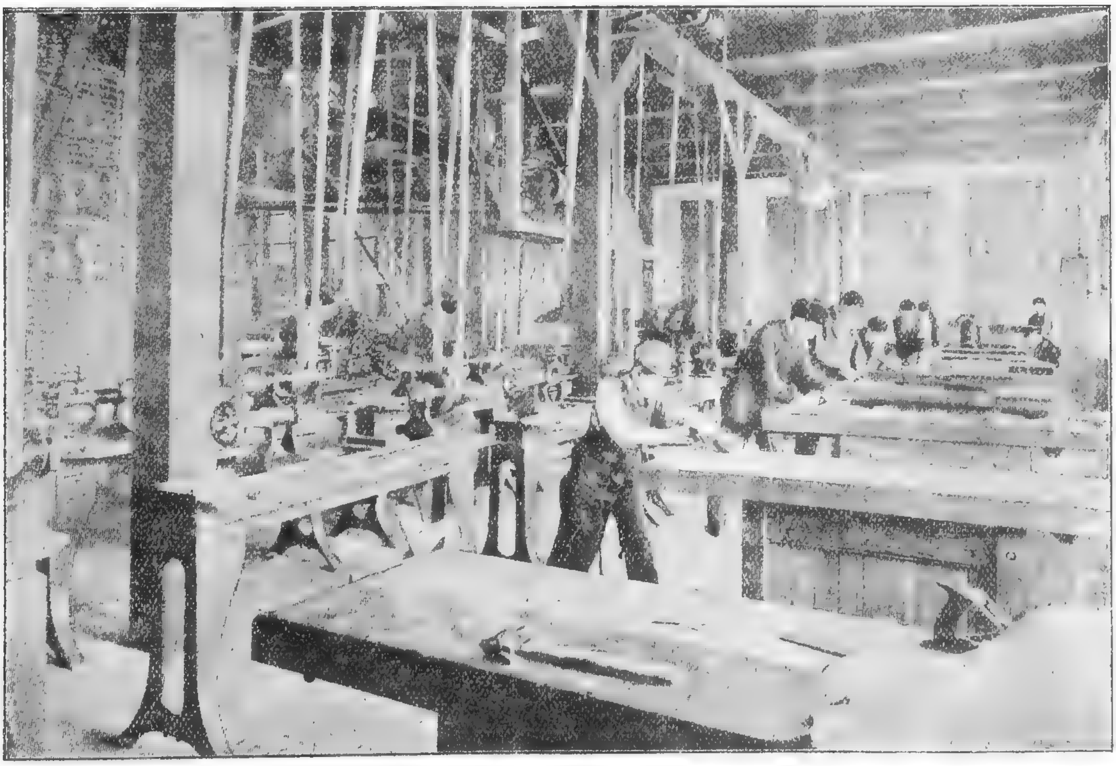
UPPER FLOOR, NEW BUILDINGS, WILMERDING SCHOOL.



MIDDLE FLOOR, NEW BUILDINGS, WILMERDING SCHOOL.



FORGE SHOP, WILMERDING SCHOOL OF INDUSTRIAL ARTS.

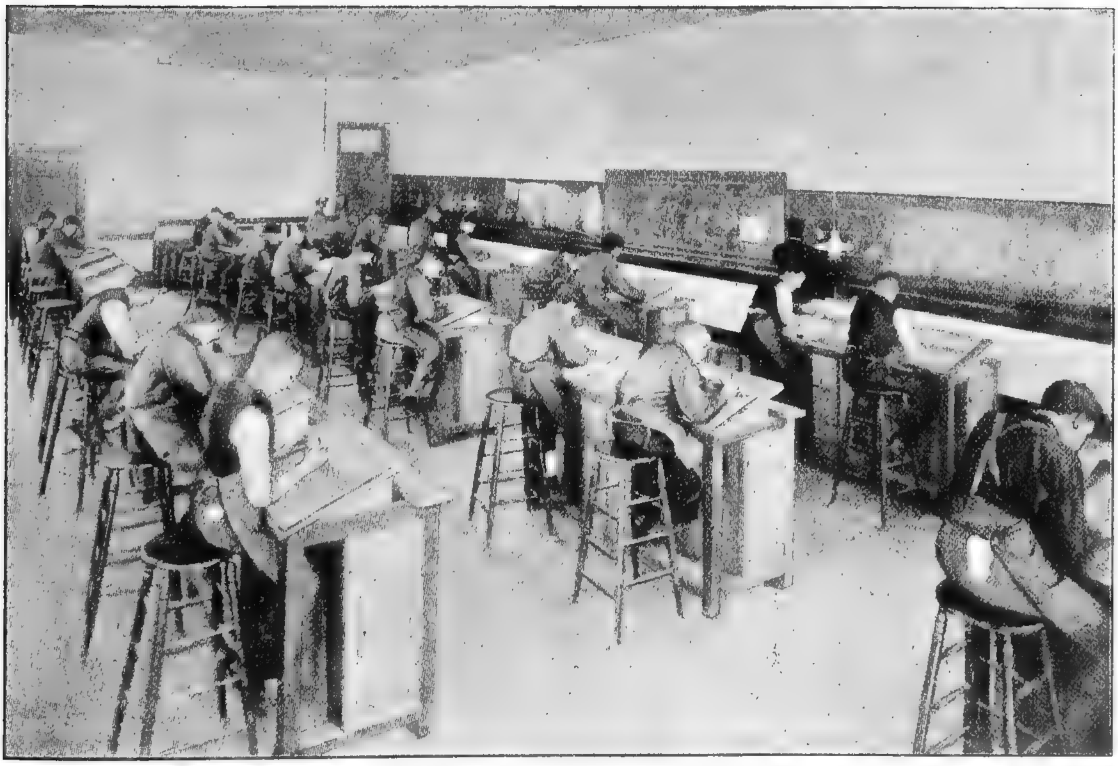


CABINET SHOP, WILMERDING SCHOOL OF INDUSTRIAL ARTS.

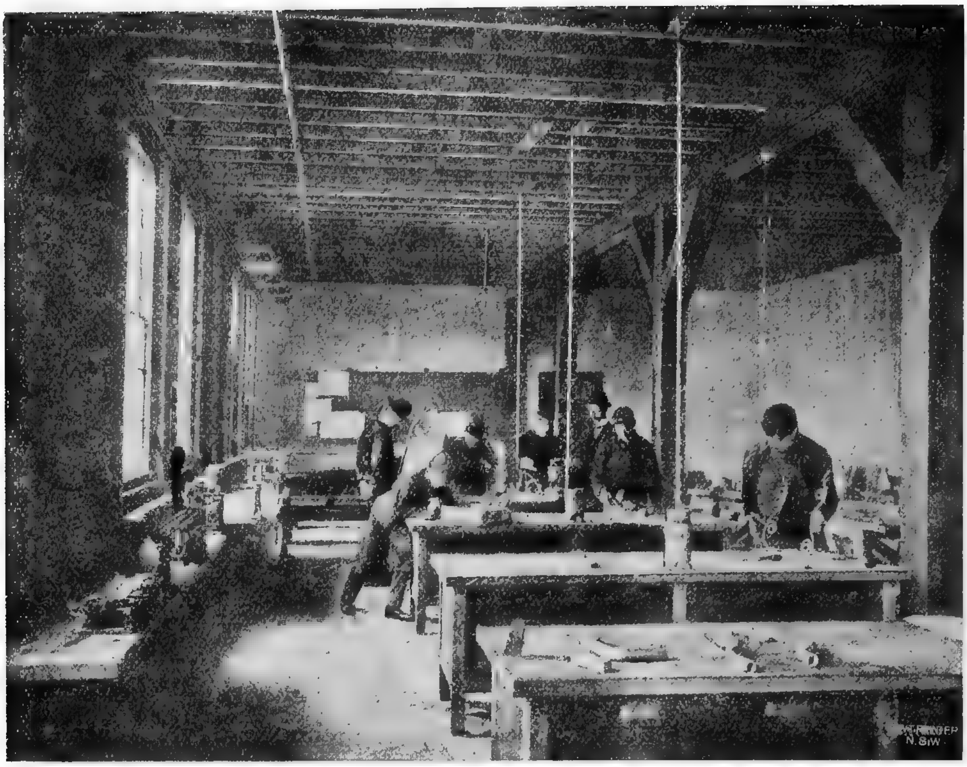
WOOD-CARVING, WILMERDING SCHOOL OF INDUSTRIAL ARTS

MODELING AND ART ROOM, WILMERDING SCHOOL OF INDUSTRIAL ARTS.

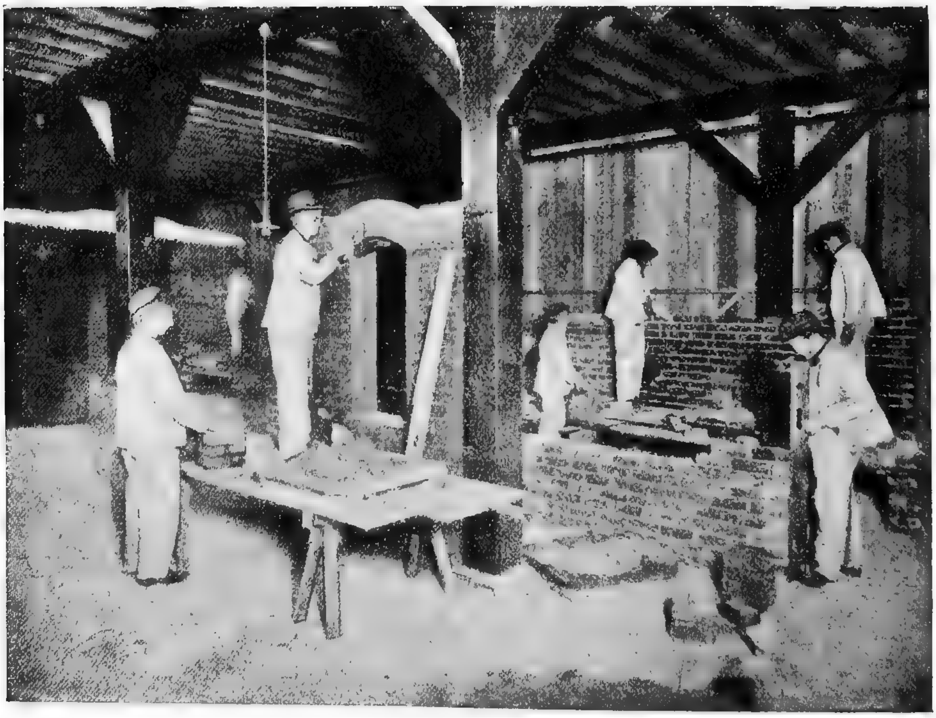
SCIENCE AND MATHEMATICS WILMERDING SCHOOL OF INDUSTRIAL ARTS.



ARCHITECTURAL DRAWING, WILMERDING SCHOOL OF INDUSTRIAL ARTS.



PLUMBING, WILMERDING SCHOOL OF INDUSTRIAL ARTS.



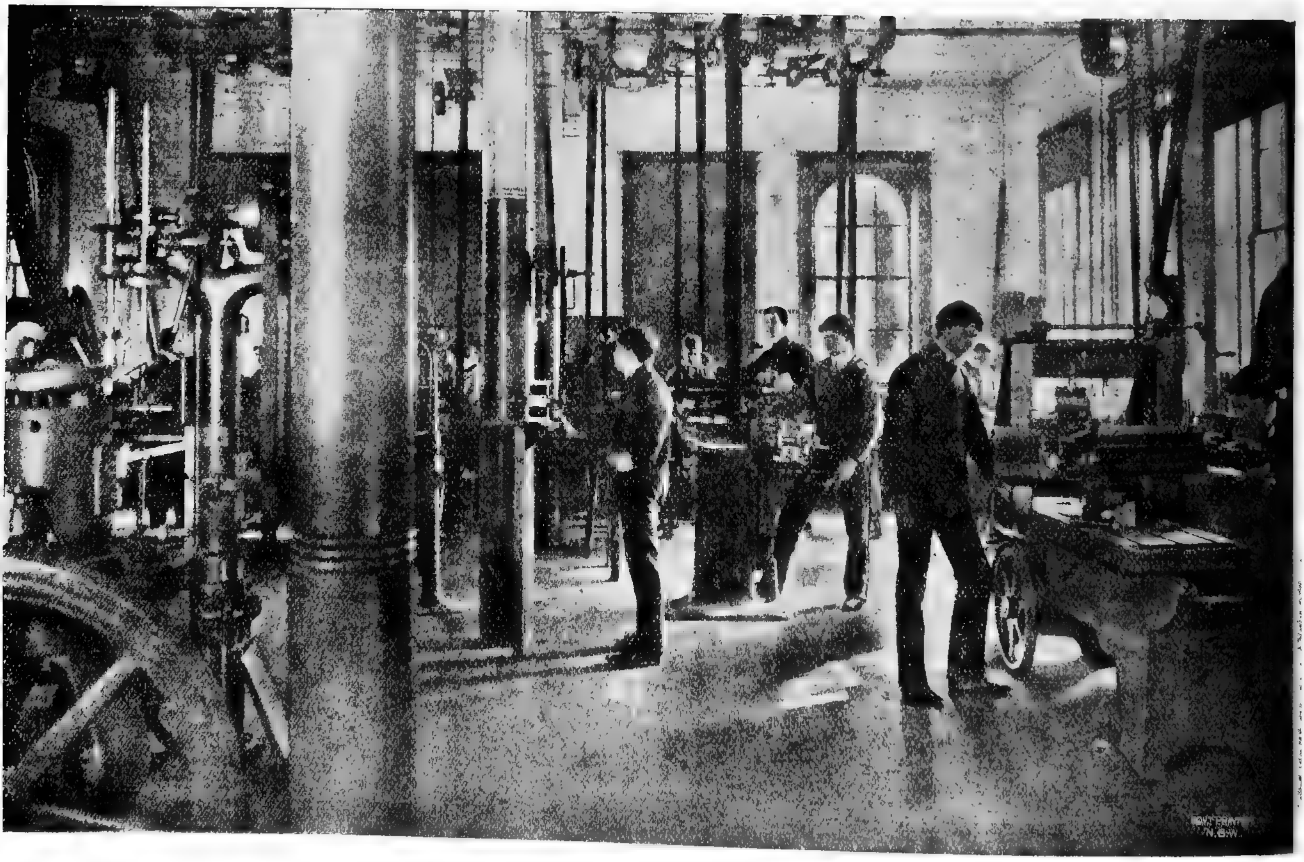
BRICKLAYING, WILMERDING SCHOOL OF INDUSTRIAL ARTS.

CHAPTER XIX.

WOOD-CARVING ROOM, POLYTECHNIC HIGH SCHOOL, SAN FRANCISCO.

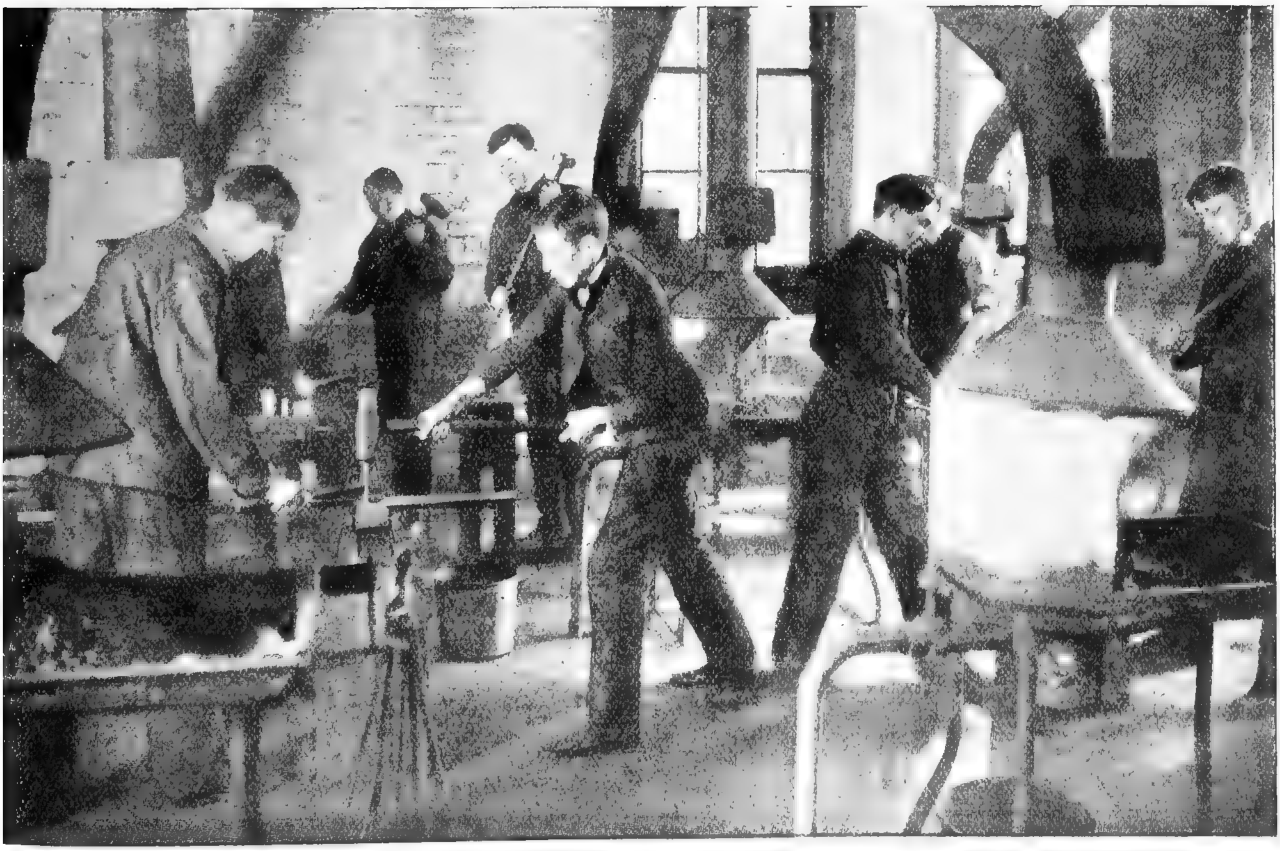
MECHANICAL DRAWING ROOM POLYTECHNIC HIGH SCHOOL, SAN FRANCISCO.

PHYSICS LABORATORY POLYTECHNIC HIGH SCHOOL SAN FRANCISCO.



MACHINE SHOP, POLYTECHNIC HIGH SCHOOL, SAN FRANCISCO.

CLAY MODELLING CLASS-ROOM POLYTECHNIC HIGH SCHOOL. SAN FRANCISCO.



FORGE ROOM, POLYTECHNIC HIGH SCHOOL, SAN FRANCISCO.

CHAPTER XIX.

Lower Technical and Industrial Education in America.

[G. H. KNIBBS.]

1. *Introduction.*—The scale on which lower technical and industrial education is provided in America is remarkable. It outwardly expresses a deep-seated conviction in the people of the United States that practical education is essential to national success.

The foundation of manual skill, and the capacity to fully profit by a course of industrial and technical education, is laid in the kindergartens. In towns of 4,000 inhabitants and over, there are no less than 5,100 kindergartens, with 6,300 teachers, and 94,000 pupils[1]; this is in a total population of about seventy-six millions for the whole territory[2].

Manual training in the primary school continues what was begun in the kindergarten, so that when the pupil turns his attention to systematic industrial, trade, or technical instruction it frequently happens that he has been well prepared and makes very rapid progress.

That there are a very large number of schools for the mechanics' arts in America is obvious when it is remembered that the income of colleges for agriculture and the mechanics' arts is about £2,000,000 per annum; probably more than that this year.

It would be an impossible task to give a complete account of the schools of the United States for technical and artisan education. One of the most remarkable and perfect developments of industrial education is that at Tuskegee, in Alabama, for coloured people. To this a whole chapter will be devoted, viz., Chapter XX. Two types of instruction will be instanced by way of illustration, one the courses in the Pratt Institute, at Brooklyn, the other the courses at the Trade School of New York.

2. *The Pratt Institute, Brooklyn, New York.*—The "Pratt Institute" is really a large educational institution, with a number of so-called departments, viz.:—

(i) A High School; (ii) a Fine Arts Department; (iii) Department of Domestic Art; (iv) Department of Domestic Science; (v) Department of Science and Technology; (vi) Kindegrarten Department; (vii) Library Department.

It has Directors to each of these, and a Board of Trustees. Founded in 1887 with 12 students, in 1902 it had no less than 3,121, and in fifteen years passed through its courses 43,640 pupils.

Its laboratories are well fitted, and it has very fine buildings, seven in number. The main building is 100 feet by 86 feet, six stories high. The Science and Technology and Electrical buildings have a floor space of about 48,000 square feet. The Library has a stack capacity for 200,000 volumes.

3. *The Department of Science and Technology, Pratt Institute.* This, one of the most important of the several departments, was established with the object of promoting "manual and industrial education, as well as cultivation in science, literature, and art." It seeks to provide facilities by which persons desirous of engaging in "mechanical, scientific, artistic, educational, domestic, or commercial employments, may lay the foundation of a thorough theoretical and practical knowledge; or perfect themselves in those occupations in which they are engaged. It offers opportunities for symmetrical, well-rounded education, through cultivation of hand, mind, and character."

There are three courses of study in this department, viz., (1) *steam and machine design* (a two-year mechanical course); (2) *applied electricity* (a two-year electrical course); (3) *evening technical classes; and* (4) *evening trade classes* (one to three year courses).

4. *Machine Design.*—The aim of this course is to "give as thorough a mechanical training as is possible in two years, and it is intended especially to prepare young men for the building of steam engines, machine tools, and similar kinds of manufacturing, or for power plant work. It fits it graduates for positions as engineers' assistants, inspectors, draughtsmen, designers of machinery, or superintendents of its construction or operation. The training given is of so practical a nature that they are sure to find it of immediate value, and it is sufficiently thorough to enable them to rise to positions of responsibility." It also aims to give "a complete mechanical knowledge and familiarity with the various types of modern machinery and the forces underlying them, with a practical training which will enable its graduates to properly solve the problems that will later confront them in the draughting-room and shop, or power plant. For this reason, much time is devoted to mechanical drawing and machine design, and to shopwork, machine construction, and mechanical laboratory. In the drawing-room, pattern-shop, foundry, forge-shop, and machine-shop, the students go through the entire process of manufacture, from the raw material to the finished product, completing a number of machines, such as a drill press, a dynamo, a milling-machine, etc."

The

[1] 1901 about. [2] Fuller information is given in the Interim Report, Chap. IV., sec 26, pp. 26-27.

The course of study is as follows:—

Programme in Steam and Machine Design, Pratt Institute, Brooklyn.

Fall Term.	Hrs. per week.	Winter Term.	Hrs. per week.	Spring Term.	Hrs. per week.
		First Year.			
Mathematics (Algebra) ...	5	Mathematics (Plane Geometry)	5	Mathematics (Plane Trigonometry)	5
Physics (Mechanics)...	5	Physics (Heat and Light) ...	5	Physics (Electricity) ...	5
Physical Laboratory... ..	6	Physical Laboratory ...	6	Physical Laboratory ...	6
Mechanical Drawing (Projections)	8	Mechanical Drawing (Shop Drawing)	8	Mechanical Drawing (Engine Details)	8
Machine Sketching	1	Machine Sketching... ...	1	Machine Sketching... ...	1
Shopwork (Carpentery and Pattern-making)	10	Shopwork (Pattern-making and Foundry)	10	Shopwork (Forging) ...	10
		Second Year.			
Mathematics (Advanced Algebra)	5	Mathematics (Solid Geometry)	5	Mathematics (Analytical Geometry)	5
Mechanism and Mechanics ...	5	Strength of Materials and Steam	5	Steam Engine and Transmission of Power	5
Machine Design	10	Machine Design	10	Machine Design	10
Str. of Materials Lab.	8	Steam Laboratory	8	Steam Laboratory	8
Shopwork (Machine-work) ...	10	Shopwork (Machine Construction) ...	10	Shopwork (Tool-making) ..	10

5. *Applied Electricity.*—The course in Applied Electricity which is intended for those who wish to enter Electrical Industries, aims at imparting "a complete practical and theoretical knowledge of the best modern types of electrical machines and appliances, and the methods of designing, building, and operating them. Great care is taken to have the instruction in class-room and laboratory meet the demands of actual practice as fully as possible so as to best prepare the student for his future work. The 'recitations' are supplemented by discussion and reports from the latest publications in the technical press; and the laboratory work covers tests on modern types of electrical apparatus of commercial size. By this means the student learns for what purposes the various types of instruments and machines are best adapted and how to operate them with the greatest of economy."

The following are the details of the Course of Study:—

Programme in Applied Electricity, Pratt Institute, Brooklyn.

Fall Term.	Hrs. per week	Winter Term.	Hrs. per week.	Spring Term.	Hrs. per week.
		First Year.			
Mathematics (Algebra) ..	5	Mathematics (Plane Geometry)	5	Mathematics (Plane Trigonometry)	5
Physics (Mechanics) ...	5	Physics (Heat and Light) ...	5	Physics (Electricity) ...	5
Physical Laboratory... ...	6	Physical Laboratory ..	6	Physical Laboratory	6
Chemistry (Non-metals) ..	2	Chemistry (Metals) ...	2	Chemistry (Qualitative Analysis)	2
Chemical Laboratory	5	Chemical Laboratory ...	5	Chemical Laboratory ...	5
Mechanical Drawing (Projections)	6	Mechanical Drawing (Shop Drawing)...	6	Mechanical Drawing (Engine Details)	6
Shopwork (Carpentry and Pattern-making)	6	Shopwork (Pattern-making and Foundry)	6	Shopwork (Forging) ...	6
		Second Year.			
Mathematics (Advanced Algebra)	5	Mathematics (Solid Geometry)	5	Mathematics (Analytical Geometry)	5
Mechanism and Strength of Materials	3	Steam and the Steam Engine	3	Steam-engines and Steam-boilers	3
Applied Electricity (Generation)	4	Applied Electricity (Transmission)	4	Applied Electricity (Motors and Lighting)	4
Applied Electricity (Laboratory)	8	Applied Electricity (Laboratory)	8	Applied Electricity (Laboratory)	8
Mechanical Drawing (Dynamo Details)	8	Mechanical Drawing (Wiring Plans)	8	Mechanical Drawing (Power Plants)	8
Shopwork (Vice-work) ...	6	Shopwork (Machine-work)	6	Shopwork (Dynamo Construction)	6

The

The equipment for each department of instruction is very fine, and embraces the most important things that might tend to a thorough practical knowledge of every subject included in these two courses. The *Shopwork* especially is held to be of unique importance to the student, "both because of its practical and technical value, and because of the development of character and fine mental training which it gives. The powers of observation are quickened by the necessity of accurate work; the reason is trained by the constant use of method and the planning of one step to follow another; judgment is gained, and the will is strengthened by the overcoming of each new difficulty; and habits of care and perseverance, neatness and accuracy, are cultivated."

6. *Evening Technical Courses.*—The evening courses aim at furnishing a "thorough and practical training in the various branches which will be of immediate value to the student, by increasing his technical information, and enabling him to advance to positions of greater responsibility in his special line. By attendance, in successive years, upon several of these courses a fairly complete mechanical or electrical course may be obtained."

The theoretical instruction is supplemented by individual practice in the laboratories or drawing-rooms.

The evening courses of technical study are (1) Physics; (2) Chemistry; (3) Applied Electricity; (4) Mechanical Drawing; (5) Mechanisms; (6) Steam and the Steam Engine; (7) Strength of Materials.

These various subjects are treated as follows:—

PROGRAMME OF EVENING TECHNICAL COURSES, PRATT INSTITUTE, BROOKLYN.

Elementary Electricity and Physics (One-year Course).

Principles of mechanics; equilibrium of forces, pressure of gases, laws of motion, work, energy, and friction; heat and ventilation.

Magnetism, static and current electricity, and electrical measurements.

There are two lectures and four hours of laboratory work each week.

Chemistry (Three-years' Course).

First Year: Principles of general chemistry and of chemical combinations; properties of the non-metallic and metallic elements and their compounds.

Second Year: Qualitative analysis; the separation and determination of the various metals and acids in solution and in solids.

Third Year: Quantitative analysis by weight and by volume; elements of assaying.

The lectures and laboratory work are distributed throughout the three years. An "Evening Certificate" is granted upon successful completion of this course.

Applied Electricity (One-year Course).

Lectures and laboratory practice in operation of dynamos and motors; principles of electricity and magnetism and their application to power plant and electric lighting work.

Mechanical Drawing (Two-years' Course).

First Year: Use of instruments; principles of working-drawings; development and intersection of surfaces; projection and shop drawing, etc.

Second Year: Advanced shop drawing; machine design.

Mechanism (One-year Course).

Lectures and drawing. Mechanical movements carefully analysed and worked out on the drawing-board. Problems on cams, gear-teeth, different forms of link-work, etc. The course in Mechanical Drawing or an equivalent is required for admission.

Steam and the Steam Engine (First Term only).

Lectures dealing with the laws of heat, combustion of fuel, and steam generation; properties of steam; condensing and non-condensing engines; value of single, compound and triple expansion.

Laboratory practice in setting slide-valves, taking indicator cards, and calculating horse-power and other data, and making tests of engine efficiency.

Strength of Materials (Second Term only).

The instruction deals with the stresses and strains in floors, beams and girders; columns, shafting, boilers and riveted joints, etc.; and the behaviour of the materials of construction under strain. Individual experiments and tests on large specimens form an important feature of the work.

This course follows Steam and the Steam Engine, and is of great value to the practical engineer and mechanic, as well as to the architect and builder.

7. *Evening Trade Classes.*—The evening trade classes "furnish a thorough and practical training in the various trades, which will be of immediate value to each one attending by giving him greater skill, accuracy, and a knowledge of the technical points of his trade, familiarising him with the best modern methods, thus preparing him for advancement and increasing his earning power."

The shops are provided with all the machines, tools, or special apparatus for each particular trade. Applicants must be between the ages of 16 and 25.

The

The following are the details of the instructions :—

Evening Trade Classes.

Carpentry (Two Years).

A practical trade course in carpentry and joinery; practical examples of house-framing, doors, sashes, etc., and all the essential points of the trade.

Also an advanced course, taking up work in roof-framing, stair-building, or in pattern-making, as the applicant may elect.

Machine-work (Two Years).

One term of bench-work and one term of practice on the engine-lathe, planer, shaper, and milling-machine. This is followed by actual machine construction and high-grade machine-work, including tool-making, with considerable practice on the milling-machine and grinding-machine. Experienced machinists will find this work of great value. An Evening Certificate is granted upon successful completion of this course.

Plumbing (Two Years).

The Journeymen Plumbers' Association of Brooklyn co-operates in the direction of this class. The manual work includes practice in soldering and wiping the various types of joints; making bends and traps; and all other forms of practical plumbing.

The lectures deal with the proper arrangements of drain, soil, and waste pipes; trapping; ventilation; supply pipes; boilers; tanks; fixtures, etc. An Evening Certificate is granted upon successful completion of this course.

Sign Painting (Two Years).

Practice in spacing and plain lettering; ornamental lettering in gold and colours on wood, glass, metal. Composition of signs; scroll-work; waggon-painting; striping; pictorial work.

Fresco Painting (Two Years).

Preparing walls and ceilings in kalsomine; lining; stencil-work; flat and shaded ornament; and flower painting. Study of design and advanced ornamental decoration on wall and ceiling.

8. *Other Departments, etc., Pratt Institute.*—The Fine Arts department, and the departments of domestic Art and Science were visited by the Commissioner. They are also well organised and equipped. It is not proposed, however, to give the courses in detail.

It may be noted that a "Science and Technology Annual" is published. This contains accounts of work done, etc. For example, the 1901–2 Annual has papers on the following original work done in the Institute :—

(1) A test of twisted joints in galvanized iron wire.
(2) Steam Engine testing.
(3) Comparison of the efficiencies for ceilings.
(4) Use of common types of incandescent lamp filaments.
(5) Determination of carbon dioxide in air.
(6) The construction of an armature winding for a 5 H.P. motor.
(7) The elevation of the elastic limit by repeated loading.
(8) A cord-coupling device for engine indicators.

This Annual is finely illustrated.

It will be seen from the very brief indication given of the courses that they constitute a high class of secondary education in technology, and the evening classes in technical and trade subjects meet the wants of those who cannot take the more elaborate day-courses.

The Institute was in its way one of the most finely equipped institutions seen by the Commissioner.

9. *New York Trade School.*—The New York Trade School, founded in 1881 by the late Colonel Richard Tylden Auchmuty, affords young men, who so desire, the opportunity of acquiring a knowledge of a trade. It is stated in the prospectus of the school that "*the apprentice system under which lads formerly learned a trade is practically a thing of the past. Conditions in all trades have so altered that very few employers now care to assume the responsibility of teaching a young man a trade.*"

The founder believed that it was difficult to obtain thorough training and yet that that was essential to good tradesmanship.

A charge is made for admission, the terms of tuition are merely nominal, and meet but a small part of the cost of maintaining the school. An endowment which the school possesses enables the institution to carry out the object for which it was founded.

The system of instruction in the school is what is known as the "Auchmuty System," said to be originated (?) by the founder. A course of instruction is arranged by which both the practical and theoretical branches of a trade are taught, so that not only is manual skill quickly acquired, but the scientific principles that underlie practical work are understood.

In the prospectus it is argued that, in the training of young men for the handicrafts, *the combination of the trade school and the workshop is best suited to modern conditions;* the trade-school to give the young man a knowledge of how to use his tools, how to do the work, and the theory of the trade; the workshop to give the young man experience, facility, and speed of execution.

The method is as follows :—For each trade a course of instruction is prepared, outlining in detail what work the student is required to perform, and its order. At first the work is simple, but as skill and a workmanlike use of the tools are acquired the student is advanced to more difficult and complicated work. The work throughout is thoroughly practical, such as will be met with in actual practice. The

The scientific instruction is given by means of prepared lectures, manuals, diagrams, and experiments.

Mechanics of skill and long experience act as instructors, and each student receives individual care and attention, careful explanation being made of every step. The instructors are constantly with the students, each member of the class being personally instructed how to hold and use his tools, how each piece of work should be done, etc.

Among the advantages claimed for this system may be mentioned the following:—

Generally a young man is employed simply to make himself useful about the shop, and neither master nor workman has the time to give the instruction that should be received. *What knowledge is obtained the lad himself acquires by observation, and as a result of the neglect of proper teaching, his progress is slow, and he can get, at best, but a limited knowledge of his trade. In a trade-school every endeavour is made to advance the student* in the trade he is learning, and by reason of the care that is devoted to his instruction, it is not long before he understands how to use his tools, and is capable of doing work that makes him of value to his employer.

An important feature of the trade-school system, is that one can quickly determine whether the aptitude for a certain trade exists. In a shop but little opportunity is given for practice, and it is frequently the case that a lad does not discover until after a long term of service, and when it is too late to make a change, that he has erred in the selection of his trade.

10. *Classes of the New York Trade School.*—The classes are:—(1) day; and (2) evening; (3) lecture classes for journeymen.

The day classes, which are open to beginners as well as those who are working at the trade, make it possible for young men residing in distant localities to obtain the advantages of the school.

The evening classes are intended to afford young men already in the trades an opportunity to improve themselves, and to give those who may happen to be engaged in occupations that promise no future, a chance to learn a trade.

Lectures are given from time to time to journeymen.

Associated with the school is a dormitory, for those who must lodge in New York; the cost is 25/- a month for lodging, and with board this runs to about 21/- to 23/- per week.

11. *Courses in New York Trade School.*—The courses are as follows:—

(1.) House Painting. (2.) Fresco Painting. (3.) Sign Painting (4.) Blacksmiths' Work. (5.) Steam and Hot Water Fitting. (6.) Bricklaying. (7.) Plastering. (8.) Sheet Metal Work. (9.) Carpentry. (10.) Pattern-making. (11.) Printing. (12.) Electrical Work. (13.) Plumbing.

With the exception of course (5), all the evening courses require an attendance of *three* consecutive terms of six months each for qualification for a certificate; for course (5) (Steam and Hot Water Fitting) participation in the instruction of *two* consecutative terms only, is necessary, and in the day class *three* consecutive months, while in all the other day classes the term is of *four* months' duration.

12. *House Painting.*—There are evening and day classes, the evening class meets from 7-9·30 for youths and men of from 17 to 24 years of age. Fee, for first term, 16 dollars; and for the second and third terms, 8 dollars each term. In the day class, instruction is given daily from 8·30 a.m. to 4 p.m. On Saturday the school closes at mid-day.

The instruction in house painting is both manual and scientific. In the former the subjects treated are:—Care of brushes and pots, glazing, treatment of new wood, including killing knots, priming, puttying, and sandpapering, second and third coats; burning off paint, painting brickwork, woodwork, and plaster walls; lining; mixing white paint, materials required for same; names of the ordinary colours and stainers and their use; mixing all colours; mixing kalsomine colours; painting in three shades; flatting; stippling, kalsomining, including preparation of size, sizing, and preparation of kalsomine; staining; varnishing; treatment of hardwood; polish white; gilding, bronzing, graining and marbling.

The scientific part of the programme treats of general painting, preparation of surfaces, colours, materials, enamelling, treatment of hardwood, staining, graining, varnishing, treatment of plastered surfaces for paint and kalsomine, gilding, bronzing, and frescoing.

During the first term of the evening class, the object aimed at is to give to students a thorough training in the groundwork of painting. In the day class paperhanging and elementary fresco painting are additional subjects of instruction.

13. *Fresco Painting.*—There is an evening class only for instruction in this subject for those between 17 and 25 years of age who already understand plain painting. During the first term three evenings a week are devoted to it; in the second and third terms, four evenings. Fee: For the first term, 12 dollars; and for the second and third terms, 6 dollars each. The first term is wholly set apart for the study of *decorative drawing*, and prepares the student for the work in colours taken up in the second and third years. The principles of light and shade are inculcated, the accuracy of eye and hand thus acquired being regarded as of the utmost value. The drawing is done from plates, casts and geometrical figures.

The subjects treated in the second and third terms are:—The preparation of walls and ceilings for kalsomine; treatment of cracks and stains; preparations of size, and how to mix kalsomine; lining; how to make and cut stencils; laying in panels; how to make pounces; how to lay on a flat ornament; how to shade from the flat; how to shade an ornament; mouldings, and how to shade them; tinting; mixing colours; wall and ceiling work.

14. *Sign Painting.*—For this course there is an evening and a day class. In the first, instruction is given from 7 to 9·30 on three evenings a week, and is for pupils of from 17 to 24 years of age. For the first term the fee is 12 dollars, and for the second and third terms, 6 dollars each. In the day class the instruction is given daily, and the fee for the course, which is of four months' duration, is 25 dollars. The subjects are treated both from a manual and scientific standpoint.

The

The manual instruction is as follows :—(1) The proper way of making boards for signs, and the method of preparing them for lettering; (2) treatment of old signs for the purpose of re-lettering; (3) styles of letters and spacing; (4) lettering, one colour; (5) lettering, two or more colours; (6) shading, blocking and lining; (7) smalting; (8) gilding on wood and on glass; (9) lettering on japanned plates; (10) lettering on muslin; (11) lettering on wire.

The scientific instruction consists of lectures on the colours principally used, and how they should be mixed to meet the requirements of different kinds of work; what colours should be used in shading and blocking to produce the effect desired; style, proportions and spacing of letters; laying out works; preparation of size; application of size and leaf; and the difference in the treatment of gilding on wood and on glass; use of japans and dryers; smalting, and such other subjects of a technical character as are usually acquired in the ordinary workshop only in a lengthy time.

In the evening class the work begins with plain lettering in the first term, and leads up to gilding on wood and glass in the third term.

15. *Blacksmith's Work.*—Instruction in this course is given on three evenings a week, from 7 to 9·30, and is for the training of youths and young men between the ages of 17 and 25. Tuition fee for the first term, 12 dollars; and for the second and third terms, 6 dollars each.

This course embraces general blacksmithing, tool-making, railing and ornamental work. In forging, students are instructed in the management of the fires, in drawing down, bending, shortening, welding, splitting, punching, chamfering, riveting, railing and housework. In vicework, instruction is given in filing to line, fitting tongues and grooves, chipping, bevels, scraping, ringwork, drilling, etc. In tool-making, machine, lathe, millers', stonecutters', carpenters', plumbers', pipe and steam fitters', tin and coppersmiths' tools are treated of; also the principles of tempering.

The shop has a modern equipment, comprising a blast and exhaust system and standard forges.

16. *Steam and Hot Water Fittings.*—This course has an evening and a day class. In the first, three evenings a week to practical work and lectures once a fortnight are given; and the fee for instruction for the first term is 14 dollars, and for the second term, 7 dollars. In the latter the instruction is given daily. Tuition fee for the course, of three months' duration, 40 dollars.

In the practical part, students, in both the evening, and day classes, are instructed in the art of setting and connecting different kinds of radiators, and of making the various kinds of coils in common use, such as return coils, mitre coils, corner coils, etc., which are constructed in various sizes. three-quarter to two-inch pipe being used. Instruction in the piping of dwellings and buildings follows, and the various systems of heating, such as steam one-pipe, steam two-pipe, hot-water, direct-indirect, and high and low pressure, are each erected in turn. On the completion of each piece of work, connection is made with one of the steam lines of the school, and the work which has been erected receives a thorough test.

The lectures include the following :—Tools, fittings, and pipe; general heating; low-pressure steam; indirect steam heating; single pipe low-pressure steam; hot-water heating; high-pressure steam heating; steam-power plant; exhaust-steam heating; power-fan or blower-system of steam heating and ventilating.

In the evening class, during the first term, the subjects treated are steam (one and two pipe), and hot-water systems, with lectures.

17. *Bricklaying.*—This subject is taught in an evening and a day class. In the former the instruction is given on three evenings a week, from 7 to 9·30, and is for the benefit of youths between the ages of 17 and 22. Fee for the first term, 16 dollars; and for the second and third terms, 8 dollars each. In the day class the instruction is daily, and is for pupils of from 17 to 24 years of age. Fee, 40 dollars for a course of four consecutive months. The instruction is manual and scientific, the former including the building of eight, twelve, sixteen, and twenty inch straight walls; return corners and intersecting walls; piers, arches, fireplaces, and flues; setting window frames, sills, and lintels; blocking, toothing, and corbelling. Fireproof brickwork. The manner of laying solid, hollow, and annular slabs, and the fitting of them into beams, walls, floors, and arches. The scientific instruction is upon the properties of mortar and cement, and the methods of mixture. Arches, their various styles and advantages. Flues, their construction and utility. Foundations, walls, bonding, etc.

Instruction is also given in the manipulation of the trowel and in mortar-spreading. Practice on eight and twelve-inch straight walls. When these are carried up plumb, and the courses of brick laid level, walls returned at right angles, piers, arches, fireplaces and flues, etc., are successively built. The brickwork is carried up as high as possible and is then torn down, when the bricks are cleaned for further use. Before entering upon an exercise, directions are given as to its methods, and then the students are required to practice under the constant supervision of the instructors until they attain to proficiency.

In the evening class, the instruction given is similar to that of the day class. Drawing of plans is also a part of the day course.

18. *Plastering.*—Instruction in plastering is given in an evening class only, which meets three times a week from 7 to 9·30, and is available for pupils of from 17 to 25. Fee for the first term, 16 dollars; and for the second and third terms, 8 dollars each.

The course includes lathing, scratch and brown coat work, hard finishing, and cornicing. In the first term instruction is given in the putting on of the various coats, and simple cornicing; the second and third terms are developments of the first.

There is a plastering room, which is divided into compartments, where the students practice until they can do their work neatly and rapidly.

The course in plastering is arranged for beginners as well as for those engaged at the trade. To apprentices it is advantageous owing to the limited opportunities for learning cornicing. The work exhibited at the school bears testimony to the skill and excellence of the instruction afforded in the plastering class.

19. *Sheet Metal Work, etc.*—For the course in sheet metal work there is an evening class and a day class, the former meeting three times a week for 2½ hours for pupils of from 17 to 25 years, employed at roofing, cornice and skylight work. Fee, for the first term, 12 dollars; and for the second and third terms, 6 dollars each. The day class meets daily. Fee for a course of four months is 40 dollars. The details of the instruction are as follows :—

Part I: (1) Cutting curves and circles; shewing the use of the shears. (2) Filing and tinning the soldering copper. (3) Soldering flat seams. (4) Soldering and upright seams. (5) Forming simple mouldings. (6) Problems in practical geometry. (7) Drawing simple details from scale drawings.

Part II: Drawing details, obtaining patterns from same, and setting together the following work, viz.: -(1) A moulded gutter with flat and return head. (2) A square moulded leader head. (3) An octagon moulded leader head. (4) A plain window cap. (5) An ornamental window cap. (6) Raised panel work. (7) A plain cornice with modillions. (8) An ornamental cornice with brackets. (9) Square turrets. (10) Finials. (11) Crosses. (12) Pediments. (13) Dormers. (14) Ventilators. (15) Flat skylights. (16) Hip skylights. (17) Bay windows. (18) Special problems.

Part III: Hammer-work.—This section comprises the drawing of details, obtaining patterns from same, and constructing the following, viz. :—In handwork: (1) Making a six-inch full ball in six gore sections. (2) Making a six-inch full ball in six horizontal sections. (3) Round finial. (4) Centrepiece for a ceiling. In machine-work: (1) Circular panels in two pieces, using machine profiles. (2) Circular moulding in two pieces, using machine profiles. (3) Segmental pediments with columns.

20. *Carpentry.*—Instruction in this course is given daily to pupils of from 17 to 24 years of age, the fee for the course being 35 dollars.

This department aims at providing a thorough and practical course in house carpentry and framing, including the drawing of plans. The early part of the course is mainly devoted to the care and workman-like and skilful use of the various tools found at the bench work. Later, instruction is given on the laying out and construction of centres and window frames; the students are taught how to make, case, and hang doors; lay beams and set bridging in same, erect stud partitions, and lay flooring. A complete course in joinery work is also given. The course includes, in addition, house construction and framing, and all that pertains thereto. The more scientific features are treated in a course of lectures.

21. *Pattern-making.*—Instruction in pattern-making is given in an evening class only, meeting three times a week, from 7 to 9·30, for pupils between the ages of 17 and 22. Fee, for the first term, 16 dollars; and for the second and third terms, 8 dollars each. The course partakes of the nature of practical work and technical instruction. The practical work is as follows :—

(1.) A series of exercises bringing into use the various bench tools used for pattern-making. The student is taught the purpose of the different tools, their use and preservation. Manual dexterity is acquired by varied practice.

(2.) A complete course of joinery, which is an important feature of pattern-making.

(3.) *Wood-turning.*—Under this section the student is taught all that concerns the lathe, its parts, the method of regulating and controlling; the nature of the wood-turning tools, their purpose and use. Exercises and practice.

(4) The following work in the direction of pattern-making, viz :—Cylinders, pipe-elbows and tees, core-boxes, cone pulleys, propeller wheels, flywheels, part of a lathe, various parts of machinery, and other practical work.

Drawing is taught in conjunction with the practical work. The student prepares and makes drawings of patterns, and work from same.

The technical instruction includes the following subjects :—Woods and their grains, best kind for pattern-making, drying and seasoning; metals, their weight and shrinkage; shrinkage of patterns and castings; wood bending; making cores, and the materials required; shellac varnish, why used.

The workshop is equipped with a modern plant of tools and machinery. The aim of the course is to give the student a broad and comprehensive knowledge of his trade.

22. *Printing.*—This subject is taught in an evening class, held on three evenings a week between 7 and 9·30, for pupils of from 17 to 22 years of age. It is specially adapted for young men employed in printing offices during the day, who possess a knowledge of straight composition. Fee for the instruction, in the first term, 14 dollars; and for the second and third terms, 7 dollars each.

The instruction deals with all kinds of mercantile printing, such as bill-heads, note-heads, statements, letter-heads, business-cards, dodgers, circulars, blank forms, tabular work, cutting and mitreing rules; also making ready for press, and press work. Particular attention is devoted to the attractive appearance of the work which is an essential to its value, and the general principles underlying this are carefully explained.

A thorough knowledge of printing, which would take a considerable time to acquire in a printing office, is gained by systematic organisation of the course.

The equipment of the printing office of the school affords every facility for purposes of instruction, and due attention is paid to every detail of job composition. The specimens of pupils' work exhibited at the school are sufficient evidence of the efficiency of this course.

23. *Electrical Work.*—Instruction in electrical work is given in an evening class and in a day class to pupils between 17 and 22 years of age. The evening class meets three times a week. Fee of 16 dollars is charged for the first term, and 8 dollars each for the second and third terms. In the day class the instruction is given daily. Fee for a course of four consecutive months, 40 dollars.

The

The different divisions included in the courses of electrical work are bell-work, burglar-alarm systems, electric gas-lighting and electric wiring, the details of each being as follows :—

In *bell-work* the student is first taught how to make, solder, and tape joints; tack up wires, and to install wire on cleats and insulators. A series of exercises in practical bell-work is given in which the various problems a bell-man should understand are illustrated. They also treat of the principles of making connections for bells, push-buttons, switches, strap keys, buzzers, floor attachments, annunciators, letter boxes, door attachments and batteries.

In *burglar-alarm systems* the student is instructed in the method of wiring for, and making connections with window, door and transom springs, and the arrangement of alarm-bells.

In *electric gas-lighting*, the work includes making connections for automatic gas burners, automatic push-buttons, spark coils, induction coils, multiple and ratchet burners.

Electric wiring embraces wiring on cleats and insulators, and moulding and tube work. Everything pertaining to work of this character is taught, and the fixtures and attachments ordinarily used in electric wiring are utilised in the erection and running of wires.

Lectures are given at intervals in the evening department, and the subject drawing is included in the third term. Drawing of plans is also included in the course for day students.

24. *Plumbing.*—The course for plumbing is given in a day and evening class for pupils of from 17 and 22 years of age. For the evening class the tuition fee for the first term is 14 dollars, and for the second and third terms 7 dollars each. In the day class the fee is 40 dollars for a course of four consecutive months. For instruction in lead-burning a further charge of 5 dollars is made. The instruction is both practical and technical, the practical work being as follows :—Seams, overcast joint, cup joint; running and calking soil pipe ; wiping ⅝-inch horizontal round ; horizontal, branch, and upright round joints; making quarter-bend ; wiping ⅝-inch upright branch, stopcock, floor flange, 2-inch ferrule, bath plug, vertical branch, wall flange ; making half-S and S traps ; wiping large and small soldering nipples, 4-inch upright and horizontal ferrules, upright and horizontal tank seams, ½-inch horizontal round, horizontal branch, upright, round, and vertical branch joints, ⅝-inch oblique round and overhead round joints, plain bib vertical branch, 2-inch horizontal round, upright round, upright branch and vertical branch joints, 2-inch short bend, with ferrule; 4-inch short bend, with ferrule ; setting up sinks, basins, boilers, wash-trays, closets, bath tubs and miscellaneous work.

The technical instruction includes the following subjects, viz. :—Drain, soil, and waste pipes ; trapping and ventilation of drain, soil and waste pipes; supply pipes, boilers, tanks, fixtures, trapping of fixtures ; pumps, disposal of sewerage in country houses, water supply for country houses, miscellaneous, correcting diagrams of improper plumbing.

By this course of manual and theoretical instruction a knowledge of plumbing is acquired which can hardly be obtained by any other than a systematic course.

Plumbing was one of the first trades to be taught at the New York Trade School, and both evening and day classes have always been largely attended. The plumbing shop is 37 x 112 feet in size, allowing not only ample accommodation for work-benches, but permitting also of the erection of basins, boilers, sinks, wash-trays and other work on an extensive scale. Each student has his allotted place at the work-bench, and a compartment in a locker, in which to keep his tools, work, and overalls. The work-benches are equipped with furnaces and pots of special make, which allow the solder to be heated by gas.

25. *The Drexel Institute of Art, Science, and Industry, Philadelphia.*—The "Drexel Institute" is organised under the following departments, viz. :—

(I) *Department of Fine and Applied Art*, containing four schools, viz. :—(1) School of Illustration ; (2) School of Drawing, Painting, and Modelling ; (3) Course in Design and Decoration (three years) ; and (4) Course in Architecture (two years).

(II) *Department of Mechanic Arts*, in which there is a systematic three-year course in mathematics, mechanical drawing, freehand drawing, science, English language and literature, history, civics, shopwork in wood and iron, applied electricity.

(III) *Department of Electrical Engineering*, viz. :—Systematic two-year course in the science and practical applications of electricity, with mathematics, physics, chemistry, mechanics, labouring work, etc.

(IV) *Department of Commerce and Finance*, which has (1) a general two-year course in commerce and finance ; (2) a one-year commercial course for teachers ; (3) office courses of one-year, viz., private secretary, book-keeping, stenography.

(V) *Science Courses*, viz., (1) special courses in mathematics, algebra, geometry, mechanics, trigonometry, surveying, calculus ; (2) courses in theoretical and practical physics ; (3) courses in chemistry, general chemistry, qualitative and quantitative analysis, organic chemistry, foods and dietetics, chemistry of textiles.

(VI) *Technical Courses*, each two years.—(1) Course in mechanical drawing ; (2) course in machine construction.

(VII) *Department of Domestic Science*, containing (1) courses in household economy and cookery ; (2) normal course in domestic science, of two years' duration.

(VIII) *Department of Domestic Arts* in which are given (1) courses in dressmaking ; (2) courses in millinery ; and (3) a two-years' normal course in domestic arts.

(IX) *Junior Course in Domestic Science and Arts for Young Women*, viz., (1) A systematic two-year course for young women, embracing English language and literature, mathematics, general chemistry, physiology and hygiene, general history, freehand drawing, business customs and accounts, principles and practical training in domestic science and arts ; and (2) Advanced elective courses in the foregoing subjects.

(X) *Normal Courses for the Training of Special Teachers*, viz., (a) in manual training; (b) in domestic science ; (c) domestic arts ; and (d) commercial courses.

(XI)

(XI) *Library School*, for the purpose of affording a systematic 1-year course in the theoretical and practical *training of librarians.*

(XII) *Courses in English Language and Literature*, viz., rhetoric, prose style, American literature, English literature, popular studies in Old World literature.

(XIII) *Department of Physical Training*, which has for this purpose (1) Institute Classes for students; and (2) special courses for young women.

(XIV) *Department of Evening Courses*, viz.: (a) Special courses in all the departments of the Institute of six months' duration; and (b) Systematic courses extending over two and three years, for which certificates are granted.

(XV) *Department of Free Public Lectures and Concerts.*—These continue during the winter months, and are of the following nature, viz., (1) afternoon and evening courses of lectures in art, science, technology, etc.; and (2) weekly organ recitals and concerts.

(XVI) *Free Evening Classes in Choral Music*, lasting from October to March, and consist of (1) The Choral Class, general training in Choral Music; and (2) the Drexel Chorus, with advanced training in oratorio music.

(XVII) *Library and Reading-room*, the library containing 28,000 volumes.

(XVIII) *Museum and Picture Gallery.*—The museum contains valuable and important collections of textiles, wood carvings, metalwork, ceramics, casts, drawings, and prints.

The picture gallery contains the John D. Lankenau collection. The Institute possesses also the paintings bequeathed to it by the founder.

The library, museum, and picture gallery are open free to the public daily, except on Sundays and legal holidays.

"While some of the courses are specially designed for either young men or young women, and are quite distinct in their arrangement and management, all the general courses are open to both sexes, on the same terms and conditions."

The academic year is divided into two terms, beginning respectively in September and February.

26. *Concluding Remarks.*—The outlines of American Technical Education given in this chapter suggest the secondary and lower forms that may be found throughout the United States. Technical and technological education of the highest grade will be dealt with much later in the Report. Several chapters immediately following will deal with other forms of technical and industrial instruction seen in America.

In conclusion it may be remarked that, in order to adequately appreciate American education, it must be remembered that the American student is usually very much in earnest in his attendance at the courses he takes up. The teaching, the general scheme, the practical work of the students, seemed, as far as was seen by the Commissioner, to be of excellent quality, and the equipment, in the way of apparatus, left but little to be desired.

CHAPTER XX.

CHAPTER XX.

Industrial and Technical Education at the Tuskegee Normal and Industrial Institute, Alabama.

[G. H. KNIBBS.]

1. *Introduction.*—Probably no form of industrial and technical education, to be found in any part of the world, exhibits more completely the significance of Froebel's message to mankind, and the possibilities of truly practical education, than does that to be found at the industrial technical schools of Tuskegee, in Alabama. Space will not permit of any references to the book by Mr. Max Bennett Thrasher, "Tuskegee, Its Story and Its Work," which gives a general account of the institution from a popular point of view.[1]

The following, while perhaps of less interest to the general public, is a sketch of the detailed nature of the work done at the Institution, and is therefore of greater value to educationists.

2. *The Tuskegee Institute, Alabama.*—As already indicated, one of the most remarkable developments of technical and industrial education in America is that which is to be found in the Tuskegee Normal and Industrial Institute of Alabama, United States, the Principal of the Institution being Mr. Booker T. Washington, who has probably done more for the practical education of the coloured people of America than any other living man. The Institution is governed by the Executive Council, at the head of which is the Principal. There is a General Superintendent of Industries, four Directors, viz., of the Academic Department, the Mechanical Industries, the Agricultural Department, and the Industries for Girls, the last being Mrs. Booker T. Washington. The other officers are the Principal's private secretary, a business agent, chaplain, commandant of cadets, officer-in-charge of boarding department, and a lady principal.

Under the *Academic Department* the following subjects are treated, viz.:—Pædagogy, mathematics, chemistry, physiology, vocal music, physics, geography, book-keeping, mind study, moral science, grammar, literature, reading, freehand drawing, instrumental music, writing, history, and gymnastics.

In the *Department of Mechanical Industries* instruction is given in the following subjects, viz.:—Tinsmithing, carpentry, blacksmithing, architectural and mechanical drawing, electrical engineering, brickmasonry and painting, wood-working machinery, brickmaking machinery, steam engineering, founding, plumbing and steam-fitting, harness-making and carriage-trimming, shoemaking, tailoring, printing, and wheelwrighting. There are twenty-two instructors in this department.

In the *Agricultural Department* the subjects of instruction include practical agriculture, home-farm, stock-raising, dairying, landscape-gardening, horticulture, bureau of nature-study. There are eight instructors in connection with this department.

In the *Department of Industries for Girls* the time is devoted to instruction in dressmaking and plain sewing, millinery, cooking, laundering, upholstering and mattress-making, basketry, and Sloyd. There are ten instructors.

For the *Military Department* there are three instructors, viz., a Commandant of Cadets, an Assistant Disciplinarian, and a Bandmaster.

Connected with the Tuskegee Institute there are also the following, viz.:—

(i) *Phelps' Hall Bible Training School*, where there are three instructors, together with the Dean appointed for the teaching of Bible history, Sacred geography, Scripture, English, and vocal music.

(ii) *The Children's House*, where instruction is given in grade work and kindergarten by three teachers.

(iii) *Housekeeping Division*, where all the details of domestic economy are given by three instructors.

(iv) *A Nurse Training Division*, the staff of which consists of a resident physician-in-charge, a matron, and a nurse.

There are also a *Library*, the "*Southern Letter*" (the journal of the school), what is known as the "*Tuskegee Student*" (another journal of the school), and the *Tuskegee Institute Bank*.

The *Department of Administration* consists of the following officers, viz.:—A private secretary to Principal, registrar, assistant to Principal's secretary, two Northern financial agents, resident auditor, two Negro Conference agents, a head book-keeper, and a cashier.

3. *History of the Institution.*—The Tuskegee Institute was opened on 4th July, 1881, under the name of the "Tuskegee State Normal School" with a subsidy of 2,000 dollars—roughly £400. In 1883 this was increased to 3,000 dollars. The property immediately belonging to the school consists now of 57 buildings, 2,500 acres of land, 800 head of live stock, more than 50 waggons, carriages, and vehicles of various kinds, and is valued at about £80,000. In 1899, the National Congress granted the school 25,000 acres of mineral land, the probable proceeds from which will be 125,000 dollars—roughly, £25,000—to be used for endowment purposes. The total value of the property, equipment and endowment, is therefore about £160,000. The

[1] Small, Maynard, & Co., Boston. 1901. Price, 1 dollar.

The *object* of the Tuskegee Institute is to furnish to young coloured men and women an opportunity to acquire thorough moral, literary, and industrial training, so that when they go out from Tuskegee, by putting into execution the practical ideas learned there, they may become the *real leaders of their communities*, and thus bring about healthier moral and material conditions. The institution also aims, through the Phelps Hall Bible Training School, to better fit young men and women for the ministry and for other forms of Christian work.

The constant aim is to so correlate the literary and industrial training, that a student cannot get the one without the other.

The buildings of the Institute are :—The *Porter Hall*, a three-storey frame-building with basement, containing the office of the Principal, treasurer, head book-keeper, and director of the Academic Department; the *Olivia Davidson Hall*, a three-storey brick structure ; the *Science Hall*, a three-storey brick building with well-equipped chemical and physical laboratories; the *Cassedy Hall*, now a dormitory; the *Alabama Hall*, a four-storey brick building, mainly a girls' department, it has also a bakery; the *Huntington Hall*, a brick two-storey building with twenty-two rooms; the *Rockefeller Hall;* the *Phelps Bible Training School Building;* the *Slater-Armstrong Memorial Agricultural Building ;* the *Hospital;* the *Dorothy Hall;* the *Children's House ;* and the *Carnegie Library.* The last is a brick structure costing about £4,000. The Institute runs two papers, viz., a weekly one, the "Tuskegee Student," for students and graduates, and a monthly journal, "The Southern Letter," which contains a record of the Institution's graduates, and is dispatched to philanthropic people throughout the United States.

The following indication is given of the view of the Institute as to *Gymnastics* and *Military Training :*

Gymnastics for Young Women.—Especial attention is given at Tuskegee to gymnastics for young women. The object is to counteract the evils resulting from habitually incorrect positions, to improve the general carriage, bring about healthy respiration and circulation, and to tone up the whole body.

The free standing movements of the Swedish or "Ling" system are followed. The work embraces all the fundamentals of gymnastics ; bending, twisting, stepping, marching, and breathing. The instructor in charge comes from the Boston Normal School of Gymnastics.

Gymnastics among the young men comes in connection with their military drill, and is under the supervision of the Commandant of Cadets.

Military Training.—The military system has been introduced for the reason that it cultivates habits of order, neatness, and unquestioned obedience. Besides, the drill is good physical training, promoting, as it does, a manly bearing. "Setting-up" exercises, according to the very latest methods used in the United States army, have been introduced. No guns are used.

The Battalion is composed of four day-school companies of about seventy members each, and about the same number from the night-school. The companies are officered by students, who are commissioned by the Institute Commandant. The day-school companies form each week day morning, before the school session.

4. *Regulations of Admission, etc.*—Applicants for admission must be 14 years of age, of good physique and character, and must be able to pass an examination in what is known as the "C Preparatory Class." They attend school four days each week, and are required to work six days in the month, one school day each week and every other Saturday. In the night-school the entrance age is 16 years, and applicants must be able to perform adult labour.

All tuition is free. An entrance fee of 2 dollars is charged. Board per month, including furnished room, laundry, light and fuel, etc., is 8 dollars. The books cost: for Junior Class, 4 dollars; B Middle Class, 4·80; A Middle Class, 6·75; Senior Class, 6·25; C and B Preparatory Class, 2 dollars each; A Preparatory Class, 3·20.

The night-school is designed for those who are too poor to pay the expenses of the day-school. Day-school students are given an opportunity of earning from 1·50 to 3·00 dollars per month, leaving only 5·0 to 6·50 to be paid in cash. A good outfit of clothing is necessary, and £9 or £10 will pay for nine months' expenses in the Institute.

Night-school students may work out at least all of their board for the first six months, but no student is paid more than about £2 10s. a month in excess of his board.

Discipline.—The scheme of discipline has some features of special interest. Regular habits of rest and recreation are insisted upon, no student can leave the grounds without permission, and when permitted must wear their regulation cap. Young women must be accompanied by a lady teacher. Students are required to bathe at stated periods, adequate facilities for bathing being provided in the school. Tobacco, intoxicating drinks, dice, and cards are prohibited. Students may not, whilst at the school, take part in political mass meetings.

Students may be "dropped" for inability to master studies, irregularity of attendance, and failure to comply with regulations. What is known as the "demeriting" system has been adopted with a view to discipline for misconduct. Thirty-three and one-third "demerit" marks constitute a "warning." Three "warnings" involve either suspension or expulsion at the discretion of the Executive Council.

5. *Elementary Technical Instruction.*—Children who attend the "Children's House" have at their disposal a two-acre block of land for instruction in agriculture. They learn the names and uses of garden and farm tools, the preparation of the ground, the making and application of fertilisers, planting and germination of seeds, growth and maturing of plants, the harvesting of crops. And they watch the work done on the home farm. The course of study being of special interest, is therefore given, and is as follows :—

First Year.—(1) Gardening : kinds, value. (2) Tools : kinds, care, use. (3) Planting : how to plant for fall vegetables; window plants. (4) Seeds : naming, value for food, etc. (5) Seeds : conditions for sprouting; value of seed leaves. (6) Testing for vitality ; when and how to plant. (7) Kinds of soil, preparation. (8) Plants for food for man, for other animals. (9) Collecting insects ; vegetable exhibition

Second Year.—(1) Soils : uses of each ; formation. (2) Hot-beds, cold frames, seed-beds, walks, terraces, keeping in repair. (3) Fall vegetables : planting, cultivation, protection. (4) Farm and garden tools ; new and old kinds compared with respect to saving labour. (5) Winter ploughing : when, where, and how. (6) Trees and shrubbery : planting, care, reasons for. (7) Early vegetables ; relations of crops to fertilising, planting, care, and cultivation. (8) Insects : names and habits ; why protect same ; method of exterminating the injurious ones. (9) Irrigation : why irrigate ; methods ; time.

Progressive Nature Study.—"The Institute's leaflets on Nature Study are used as suggestive steps in this work. Frequent excursions to the school gardens, truck farm, neighbour's gardens and fields, furnish splendid opportunities for the little minds to become acquainted with Nature's God."

The

The Kindergarten course undoubtedly lays the foundation of the industrial instruction, and its etails are quoted as of sufficient general interest.

Kindergarten Course.—"The underlying thought of the Kindergarten year is the connection of the seasons.

"*Fall.*—Subject: Preparation of Nature and her creatures for winter. Work-time in contrast to rest-time.

"The changes are illustrated by drawings with coloured crayons and by the paper cutting.

"In the early fall many of the talks are on the family; the child's relationship to mother and father leading him to an appreciation for Thanksgiving Day, the salient thought of which is an expression of gratitude for all the blessings which come into his life.

"The preparation for the winter rest-time culminates in the Thanksgiving Party, and the spirit of thankfulness is expressed at Christmastime in the gifts that are made for the parents.

"*Winter.*—Subject: Protection.

"The carpenter is the protector of the family.

"Houses of different dimensions are built with the building gifts, which develope the ideas of high and low, large and small, wide and narrow.

"The shoemaker is a symbol of personal protection. His shop is visited, and the children watch him at his work.

"Shoes are folded with paper and moulded with clay.

"Knights and soldiers are symbols of State protection.

"We endeavour to develope the heroic and cultivate and strengthen the spirit of patriotism through the celebration of Washington and Lincoln's birthdays.

"The ideal of all that is good is presented to the child in the songs of the knights.

"Drums are modeled and music cut from paper.

"*Spring.*—Subject: Awakening of life.

"Talks are given emphasising the importance of wind and sun. Windmills and weather vanes are folded with paper.

"*Flowers and Birds:* The 'pussy' willow is the first sign of awakening life. Birds, birds' nests and eggs are modeled and jonquils drawn.

"The Easter thought is introduced through the light songs, and the Bible Easter Story told.

"The rabbit is installed in the Kindergarten with a generous nest of 'Easter eggs.'

"In April the birthday of Frederic Froebel is celebrated; badges are made in the form of Froebel's favourite flower (the daisy) and worn by the children.

"*Gardening:* Seeds which the children bring are planted in the garden, and small tools are given them to carry on this interesting work.

"Games, illustrative songs and stories are a part of each day's programme. The games teach habits of animals, and help children to be more in sympathy with them. The songs bring forth some truth, increase the love for music and emphasise rhythm. Stories lift the children from their environments; each has some good moral, and they are important in that they improve language."

6. *Department of Mechanical Industries.*—In all the Departments of Tuskegee three objects are kept constantly in view, *viz.*:—

(1) To teach the dignity of labour.
(2) To give the student a thorough knowledge of a trade.
(3) To enable the student to pay a portion of all their expenses in labour.

The courses in the Department of Mechanical Industries are as follows:—

(1) Carpentry. (2) Repair Shop. (3) Blacksmithing. (4) Printing. (5) Wheelwrighting. (6) Harness-making and Carriage-trimming. (7) Painting. (8) Machinery, engineering and founding. (9) Shoemaking. (10) Brickmasonry and Plastering. (11) Brickmaking. (12) Sawmilling. (13) Tinsmithing. (14) Tailoring. (15) Mechanical Drawing. (16) Architectural Drawing. (17) Electrical Engineering; and (18) Canning.

7. *Carpentry, etc.*—The work in this division is subdivided into (i) Carpentry proper, (ii) Wood-turning, and (iii) Cabinet-making. The course of study covers three years, as follows:—

First Year.—Names and uses of tools; sharpening and setting for use. Working out pieces of timber to various gauges and lengths; forming angles and plain dovetailing as applied in framing. Sketching and making plain brackets. Lectures on general topics. Study and construction of sixteen set problems in carpentry. Observation lessons.

Second Year.—Framing. Inspection of brick work. Straightening, squaring and plumbing. Bracing, tying and bridging. Sizing studs, joists, etc. Formation of cornices. Setting window frames. Shingling and flooring. Rafter cutting. Weather-boarding and boxing. Lectures and supplementary studies. Study of sixteen problems in carpentry, from 6 to 11. Selection of building sites and examination of building soils, etc.

Third Year.—Stairway building. Rises and treads. Making patterns of stairs. Hints in wood-carving and application in cabinet-making. Drawing brackets from original and selected designs. Furniture-making. Care and use of machinery, machine setting and regulating, etc. Bill of lumber, estimates. Lectures and supplementary studies. The sixteen problems in carpentry completed. Estimates of material.

The course in *Wood-working Machinery* is of one year's duration, and is as follows:—

First Quarter.—Names, uses, and attachments of machines. Their setting-up, speed-regulating, and care. Brazing apparatus and the care of it. Names of edged-tools used with the machine, the method of sharpening and using them.

Second Quarter.—Practical work on each machine from black-board designs or sketches. Wood-turning.

Third Quarter.—Course in wood-turning. Practical work on all machines.

The *Cabinet-making Course* is identical in duration with that of Carpentry proper, and its object is to give students a complete knowledge of the art.

Carpentry; the Repair Shop.—This is but an auxiliary to the regular Division of Carpentry, the course of study and the duration of the course being similar.

8. *Blacksmithing.*—The course of study in Blacksmithing is of two years' duration, the details of which are as follows:—

First Year.—Cleaning the shop. Making fires. Names, uses, and care of tools. The importance of keeping water and coal in the troughs, also economy. Striking. The various size drills, stocks, and dies. The use of the hand hammer and tongs. The figures on the rule and measurements. The different sizes of iron. The formation and kinds and grades of iron and steel. Welding iron, and the different kinds of welds. The use of sand. Practice in making lap links, lap rings, staples, hasps, S-hooks, gate hooks, hame hooks, and round rings. Resetting tires and the use of the traveller. The use of welding compound, welding steel. Welding and setting axles. Measurement of the track of axles. Welding and setting tires, also dish of new wheels. Making clips, nuts, brace ends, also welding braces and the proper lengths. Putting work together. Bench work.

Compositions are written on these subjects monthly, also monthly examinations are given.

Second

Second Year.—Horseshoeing. The condition of a shoeing floor. How to make a shoer's fire. The name and use of shoeing tools. The mould and method of striking on a shoe. The names and sizes of shoes and nails. The manner of filing and pulling off a shoe, trimming the foot and clinching a shoe. The different parts of a foot and how to drive a nail. The different kinds of shoes used for horses with various ways of travelling. Special lessons in fitting. Waggon work, dash and rail work. Fender work. The making and tempering of tools. Work from drawing. Repairing different parts of buggies. Estimating and cost of different things and jobs. Hanging and trimming up. Buggy gear work, body and hoop work. Practice in truck and carriage forging. Repair work of an advanced order is done by the students while this course is being taught.

Compositions are given monthly on each subject.

9. *Course in Printing.*—The course in Printing is considered one of the most important branches of instruction in the school. The complete programme of study is of three years' duration, the details being given hereunder, viz. :—

First Year.—Care of office, oiling presses, treatment of rollers, learning type names, point system and tools. Technical terms, proving signs and proof-marks, lay of the case, proper position at the case, and general review.

Second Year.—Care of presses, making ready and running a platen press, regulating impression on platen press, distribution of colour, care of ink and mixing colours, names and sizes of paper, use and care of the paper-cutter.

Third Year.—Composition, proof-reading and type-setting contests. The importance of uniform spacing, careful justification, accurate punctuation, and correct capitalisation is insisted on. Measuring type, casting off copy and imposition. Making up and locking newspaper forms. Making ready on cylinder press; overlays and underlays for type and various kinds of cuts. Making out orders, rendering estimates and writing essays on subjects relative to the trade. Lectures on colour printing, journalism, bookbinding, the progress of the printer's art and allied subjects.

Instruction in this course embraces all the usual forms of printing, the principles underlying attractiveness of appearance are fully explained, and originality is rigidly insisted on.

10. *The Course in Wheelwrighting.*—The course of study in wheelwrighting covers three years, a knowledge of its details may be gathered from the following description :—

First Year.—Care of tools. Elementary, with saw, plane, drawing knife, chisel, and spoke shaver. Kinds of joints, splices, mortises, tenons, mitres. Kinds of wood and their selection.

Second Year.—Pattern-making; working by patterns. Making wheelbarrows, carts, trucks, and wheels. Construction of waggons, carts, and drays. Sketching work.

Third Year.—Practice in building wheels continued. Copying with dimensions into note-books, and working from copy continued. Building buggies, bodies, and gears. Construction of buggies and phaetons.

The instruction in *wood-turning*, which takes place during the second year, is identical with that of the Carpentry Section.

11. *Harness-making and Carriage-trimming.*—To instruction in harness-making and carriage-trimming two years and three years respectively are devoted. All of the harness used by the school and a large quantity sold to the public is made by the students in this division each year. The following are the details of the work in harness-making :—

First Year.—Care of shop, names and care of tools, threadmaking and practice stitching. Quality and preparation of leather. Names and dimensions of straps. Repairing all grades of harness. Cleaning and oiling harness. Making odd parts of harness, such as hame-straps, shaft-tugs, bridle fronts, side straps, crupper docks, girths, etc. Fitting and finishing up harness.

Second Year.—Review of work of first year. Names and grades of trimmings, and names and grades of leather. Patent leather work. Cutting patterns. Making fancy harness. Making all grades of cart and gig saddles. Inspection and criticism of work.

The details of the course in Carriage-trimming are :—

First Year.—Use of scissors and needle. Basting. The use of the tack hammer. Stitching on machine.

Second Year.—Drafting, pattern-cutting, making cushions, repairing.

Third Year.—Making cushions, continued. Drafting and cutting material for buggy tops. Setting and trimming.

Night-school students take drawing lessons twice a week.

12. *Course in Painting.*—The course of study in painting is of two years' duration, the details thereof being as follows :—

First Year.—Cleaning shop and keeping tools in order. Names and uses of brushes. Names of colours. Sandpapering and priming. Model work. Priming houses. Finishing; interior work, hard oiling and staining. Exterior work; estimates, waggon painting, mixing and colouring putty.

Second Year.—Advanced work in interior and exterior decorating. Carriage, furniture, and sign painting. Mixing paints, gilding, glazing, varnishing, and striping. Finishing, graining, tinware painting. Advanced work in staining and hard oil finishing. Estimates.

In all the branches harmony of colour is the prime factor. The theory class meets daily with the exception of Saturdays. The night-school students have drawing-lessons once a week.

13. *Courses in Machinery, Engineering, and Founding.*—The machine-shop is equipped with modern machine tools driven by power from an "Atlas" steam-engine.

Lathe, planer, shaper, and drill-press work, as well as bench work and a course in erecting is given. All repairing of the mechanical equipment of the school, including steam-pumps, steam-engines, wood-working machines, printing presses, metal working machines, etc., is done in the machine shop. About fifty different machines outside of this shop, including laundry machinery, agricultural machinery, dairy machinery, etc., are in daily operation, furnishing the best illustrations for the theory work of this division. In the steam engineers' course, the young men have studies from eleven different steam-engines, seven steam-pumps, twelve steam-boilers, a complete water works system, with miles of piping, and the various water works' equipment—valves, gauges, recording apparatus, etc.

A foundry is in daily operation. Two cupolas are used with blasts from Sturtevant blowers. One is a No. 30 Caullian cupola, the other a 17-inch Purdue University cupola. Two "heats" are made a week, 500 to 1,500 lb. of metal being poured off each week.

The

The details of the *machinery course* which is of three years' duration, are as follows :—

First Year.—Use of rules, squares, and calipers. Instruction in foundry practice. Vice work in chipping, filing, and scraping. Use of taps and dies. Theory of thread standards and measurements. Laying off work for drill press and shaper. Use of punches, centres, gauges, templates, files, gauge, and cape chisels. Babbitting small boxes and treatment of babbitt. Naming machinery parts and technical terms. The action of steam in the steam-engine. Packing unions, glands, and man-heads. Machine shop arithmetic and written work. Speed of machine tools on various metals.

Second Year.—Drill press work with twist drills. Grinding drills, reamers, and counter-borers. Use of various steels, tempering and annealing. Foundry work in moulding and cupola management. Boring bars in drill press. Valve setting on steam-engines. Engine governors and valve motions. Duplex pumps, steam traps, and water meters. Proper methods of piping steam machinery. Practical work with injectors, lubricators, and air-pump. Shaper work in slotting, grooving, and bevelling. Planer work in straight, oval, and bevel cuts. Lathe work in turning straight ; and oval and general repair work. Arithmetic in machine shop problems. Boiler management, safety-valves, reducing valves, gauges, and trimmings.

Third Year.—Use of jigs and templates in interchangeable work. Use of micrometer and vernier calipers. Lathe turning for shrinking fits. Use of mandrels, arbors, and chucks. Erecting machines, with instruction in foundations, and use of hoists, pulley-blocks, and lining machines. Five weeks as engineer of electric light plant, with three engines to adjust and manage. One given period as foreman of machine shop. Cutting worms and inside threading. The steam-engine indicator, reducing motion and diagrams. Instruction in gear wheels and pinions. Work in turning, drilling, planing, and shaping in tool-making. Machine shop arithmetic. Original work in machine design.

The courses in the *foundry division* are of only two years' duration. Students first of all learn the names and uses of tools ; how to cut and temper sand for moulding, cleaning castings, ramming-up drags, lifting and closing flasks, are elements, all of which precedes moulding.

They then learn the practice of setting up simple moulds, the use of the clamping bar, the names and uses of the different kinds of facings used in the foundry, venting, sponging, and drawing patterns and gate cutting.

In the *second year*, students are instructed in the carrying and pouring off iron by use of hand ladles, at which time the qualities of iron are explained for the different grades of moulding. Skimming and feeding are carefully practised. The student is given the higher branches of moulding, as in pump and engine building, stone moulding, fancy return work, core-making, and core-venting. Cupola management, lining cupola, mixing iron, making charges, tapping out and stopping in. The management of the foundry, as an ideal shop, is particularly associated with every step given in the course of study.

14. *Course in Shoemaking.*—Most of the shoes worn by teachers and students of the school are made in the shoemaking shop, as also are many for outside customers. Repairing of shoes for the whole school is also done there. During the year of 1900 there was added to this division a full set of Goodyear shoemaking machines, at a cost of about £160, exclusive of cost of engine for running same. The set consists of a Goodyear welt or turning machine, a Goodyear rapid lock-stitcher, a welt-channeler, an outer-sole channeler, a welt-beater, a bobbin-winder, a welt-groover, and a welt-splitter. Besides this machinery, two Wheeler and Wilson latest improved machines have been added to the upper-making department of this division.

The course of study is of three years' duration, the details thereof being as follows :—

First Year.—Thread-making, waxing threads, and putting on bristles. Names, uses, and care of tools. Putting last in shoes. Use of awl and bristles. Stitching and sewing-up rips. Theory class. Mechanical drawing. Putting leather in case before use. Kinds and uses of leather. Patching and half-soling. Single and double sole sewed shoe. Pumps and nailed shoes. Selection of sole and patch leather, finishing higher grade repair work of different styles. Setting edges and finishing. Inseaming and stitching outsoles on new shoes.

Second Year.—Review of work of first year. Preparation of bottom stock for new shoes. Drafting and cutting patterns. Freehand drawing. Upper fitting. Measuring feet. Fitting last to measure. Rounding up insoles for different styles of buttons. Cutting channels. Putting in all styles of boxes. Lasting, inseaming, building different style heels, shaping and finishing. Review of work of first and second terms. Higher grade of new work, such as double soles, Scotch bottoms, pumps, bevel and square edges, cork shoes for deformed feet. Business methods.

Third Year.—Goodyear machines. Care of machines, how and where to oil them. Threading and putting in wax. Practice work. How to run machines, set needles, sharpen knives of the different groovers and channelers, and set same. Number of awl used to match needles. Different kinds of tables used in making certain styles of shoes. Names of the parts of the machine. Sewing inseams and outseams. Speed in running the machines and knowledge of repairing and keeping the machines in running order.

In Mechanical and Freehand Drawing, the student learns an art that enables him to design and correctly make patterns of his own creation.

15. *Brickmasonry and Plastering.*—All the brickwork on buildings of the school is done by students of this division, under the supervision of the instructor. Plastering and repair work, both on the inside and outside of the buildings, is looked after by the students of this division The theory is given in the class-room, and practical work in the actual construction of the buildings.

The course of study covers three years, the details being given as hereunder :—

First Year.—Names and care of tools in Masonry Division. The preparation of material for different kinds of brick-masonry. One hundred and eight lessons in the fundamental principles of the trade from Baker and Kidder.

Second Year.—Staking out buildings ; the putting down of the foundations. Limes, cements, and mortars. Limes: characteristics of slaking and mixing. Sand : why used and composition. Research work from trades journals. Estimating on different kinds of work embracing all the features of the trade.

Third Year.—Foundations : pile, sand, clay, and rock foundations. The student is required to discriminate and draw conclusions concerning foundations. Shoring and under-pinning is studied as to "jacking-up" and moving houses.

Students are required to do laboratory work and analysing. Plain reading at sight is necessary for gaining a certificate.

16. *Brickmaking*.—On one of the school farms has been found beds of clay suitable for making brick. From these beds the school has already been able to make enough brick to build its most substantial buildings. The bricks are made, laid, and burned by the students, thus reducing the outlay for building to the minimum of cost. The instruction in every way is valuable. The latest machinery has been here installed ; the output per day during good weather being 20,000 bricks.

The course of study is as follows :—

Clay : preparation, bulked or heaped, rotted, cut in pones, shaped, dressed, turned. Tools : shovels, picks, hoes, barbe or mould, strikers, grinding wheel and pit. Setting brick in kiln. Time of burning.

17.

17. *Sawmilling.*—The power to run the machinery of the saw mill is supplied by a 40 horse-power engine. It is furnished with the following machinery :—A 52-inch circular saw, a No. 5 endless bed surfacer, having a dressing capacity of 10 x 12 inches, a 6 x 26 inch flooring and surfacing machine, a cut-off saw, two lathe saws, an emery stand and grindstone, a mill to grind corn, etc., for stock. The course of study is as follows :—

Fall Term.—Names, use, and care of machines. Defects of timber trees. Felling timber trees and loading logs on waggon. Measuring lumber and wood.

Winter Term.—Scaling logs to find their contents in board measure. Grading lumber. Running planer and other machines. Care of belts.

Spring Term.—Saw-filing and caring for saws. Grinding planer knives and cutters. Designing and making cutters for mouldings. Calculating speed of pulleys. Arrangement of machines in a planing and saw mill.

18. *Tin-smithing.*—Nearly every kind of tin work is done in this division, from the covering of a house to the making of pepper-boxes. Apprentices have every opportunity to become first-class tinsmiths. More than 2,000 fruit-cans were made in a year, as well as many other useful articles.

The shop is well supplied with tools, such as folding machines, grooving machines, wiring machines, setting-down machines, large and small burring machines, gutter machines, circular shears, stove-pipe machines, vices, hack saws, wood folders, 22 x 30 inches, soldering coppers, bench shears, snip shears, large mantles, horn stakes, hatchet stakes, candle-mould stakes, hollow punches, square stakes, small solid punches, rivet sets, cutting nippers, roofing tongs, double seaming tongs, hand seamers, wing dividers, pliers, squares, mallets, breast-drills, fire pots, etc.

The course of study is of two years' duration, the following being the details thereof :—

First Year.—Names and uses of tools. Marking and cutting straight lines. The method of cutting round pieces and curves. Manner of holding the soldering coppers, so as to turn burs and locks. How to dress soldering coppers and use them ; by stopping holes and soldering broken seams, in repairing. The use of square and compass in laying out the work ; making cups, small buckets, and other small articles. Making small pans, biscuit-cutters, cake-cutters, and water dippers. The more important use of square and compass, as in measuring curves and angles. The making of conductor pipes. The putting together of tin for roofing. The different fluids and other material used as a flux.

Second Year.—First : To make large vessels, including wash pans, dish pans, milk pails. To do general repairing, such as bottoming large pans, large cans, light repairing on roof. How to solder the different metals. How to draft patterns for making pans, coffee pots, milk pails, and the different kinds of buckets, and how to make them hold any given number of pints, quarts, or gallons. To make stove pipes. To put on the different kinds and styles of roofing. How to draft patterns, ellipses, polygons, elbows, for the different shaped vessels from two pieces, and afterwards from any number of pieces as may be desired. During this term the student learns to make all the different patterns, and should have such a foundation as to enable him to go out and work at his trade.

There is a theory class three times each week, when the student is taught the proportions of different sized vessels, why they are made in different shapes, why a seam should be put in certain places, the kind of tin to put in the different vessels, how to know one kind from another, whether tin or zinc should be used in making or lining a vessel, whether galvanised iron, zinc, or copper should be used, how solder is made, what effect the weather has on different metals, etc.

19. *Tailoring.*—In this division all the uniforms for the male students, as well as suits for students and teachers, are made. The object is to teach the trade thoroughly, and in this much success has been achieved. Girls have been allowed to enter this department, and are being taught tailoring under the direction of the instructors in charge. Very satisfactory results have been attained. Young women are admitted to this division on an equal footing with young men, and many of them shew equal aptitude.

The girls in this division make all the overalls, common pantaloons, vests, coats, etc., used by the students and industrial instructors.

The course of study extends over three years, the details being given hereunder :—

First Year.—Care of shop and irons. Position on tailor's board. Practice in the use of needle and thimble in back-stitching and felling. Cleaning and repairing. Working button-holes. Finishing various styles of pant's pockets. Common pants-making. Uniform pants-making.

Second Year.—Review of work of first year. Stitching cord seams and finishing vest pockets. Fine pants-making. Making common vests.

Third Year.—Review of work done in first and second years. Making coat sleeves and finishing the different kinds of coat pockets. Fine vest-making. Uniform coat-making. Common citizen coat-making. Review of work done in second and third years. Fine coat-making. Drafting Drafting and cutting. Harmony of colours, and how to select suitable trimmings. Taking measures. Economy in cutting.

20. *Mechanical Drawing.*—All students in the day and night school, who are in the Mechanical Department, and in and above the "A" Preparatory class, are required to take instruction in this division. The work of the first year is largely preparatory. It begins with simple geometrical drawing to familiarise the students with drawing instruments, and to teach them accuracy and neatness. This is followed by work in projection, which finds application in scale drawings of simple objects.

The student is required to make satisfactory, carefully-dimensioned, freehand sketches from measurements taken by himself of the complete object and its parts. Drawing is taught in the drawing-room by lectures and exercises at the blackboard. Models and cuts shewing examples of approved practice are used by the instructor, who also gives personal attention to each student's work at his desk as it progresses.

Strictly speaking, mechanical drawing begins with the second year of trade work, with the study of materials and working drawings, and during the last quarter of the third year students are given instruction in the making of blue, solar, and black prints. During the fourth year several excursions are made by the class to the shops, buildings under construction, brickyard, etc. In such excursions full notes must be taken, and a satisfactory written report upon the things seen and examined submitted.

As soon as a fair knowledge of the instruments has been attained, a thorough drill in projection drawing, in which freehand sketches are made and measurements taken—these sketches being converted into scale drawings—is then applied to the representation of definite objects. The study of design is carried

carried so far only as to secure an understanding of the principle, facility, and accuracy in the construction of drawing plans. In the exercise in designing, the student makes first a sketch plan of the thing proposed, he then constructs a scale drawing, carrying its development into minor details.

The course of study is given in five classes, the details taught in each being of the following description :—

"A" Preparatory Class.—Names and uses of instruments, lettering, construction of plain geometrical figures, simple projection, explanation of scales, objects drawn from scales, freehand sketches.

Junior Class.—Projection, working drawings, detail drawings, tracing, materials, freehand sketches, design, Isometric drawing.

"B" Middle Class.—Advanced problems in construction, detail drawing, material, working drawing, design, freehand sketches, blue printing.

"A" Middle Class.—Design, advanced problems in construction, specifications and contracts, estimates. Strength of materials.

Senior Class.—Problems of construction. Superintending construction. Advanced problems in design. Graphical statics.

21. *Architectural Drawing.*—The object aimed at in this course is to give thorough instruction in drawing, building, construction, and design. In all cases the general mechanical and artistic training is supplemented by studies in the Academic Department, unless by examination or otherwise, the individual is exempted.

The course covers three years, and is not open to students below the Junior Class. About one-half of the time is devoted to work in the drawing-room. The details of the course are the following :—

First Year.—Names and uses of instruments. Freehand drawing ; objects. Lettering ; mechanical. Geometrical figures. Geometric problems in construction. Elements of plain geometry. Projections ; points and lines. Projections ; angles and planes. Measured drawings. Working drawings. Various scales. Detail drawing to scales. Freehand drawing ; composition. Projections and developments ; solids. Isometric drawing. Tracing and blue printing. Shop work throughout the year.

Second Year.—Materials. Freehand drawing ; composition. Lettering. Elementary construction. Isometric construction. Applied geometry : angles and planes. Applied geometry : angles and solids. Problems in construction. Elementary design. Freehand drawing ; pen and ink. Lettering ; special problems. Shades and shadows. Measured drawing. Advanced problems. Detailing. Geometric solids. Shop work throughout year.

Third Year.—Freehand drawing ; outdoor sketching. Lettering ; special problems. Practical geometry and mensuration. Strength of materials. History of architecture. Freehand drawing ; study in charcoal. Specifications and contracts. Designs ; elective. Freehand drawing ; outdoor problems. Elementary perspective. Advanced design. Working drawings and detailings ; estimates. Shop work throughout the year.

On entering the third-year class in this course, the student, along with his regular work, is given actual practice in office work and general superintendence. The Institution furnishes excellent advantages in this particular, also in the many trades' shops which are constantly in operation, and which the student is required to visit periodically, with and without the instructor.

Students are required to attend lectures in heating, electric lighting and plumbing at specified times, along with the industrial classes. Certificates are granted students who complete the course and pass the required examination.

22. *Electrical Engineering.*—The work in this division is designed so as to give the students a thorough knowledge of the simpler laws of electricity and magnetism, and a practical working knowledge of electrical apparatus. It is founded on a scientific basis, though essentially practical in character.

There are special courses arranged in dynamo-tending, line construction, electric wiring and telephony.

The electric equipment of the school consists of a 50 k.w. 60 cycle monocyclic generator and its exciter ; 800 16 c.p. lamps connected, a telephone exchange, and several annunciator systems. The whole of the above is used for instruction purposes.

23. *Canning.*—During the summer vacation, the institution operates a steam canning plant, for the double purpose of preserving its own stock of fruit and for teaching the industry of canning to a class of students who remain at the school during the vacation. In an average fruit year about 5,000 gallons of fruit are put up by the plant. One-gallon tin cans are used. These cans are made in the school's tinshop by the class of young men who are learning the tinsmith's trade. Most of the fruit comes from the orchards of the school. Generally about 2,000 gallons of blackberries are canned.

24. *Department of Industries for Girls.*—The industries for girls' department constitutes another great branch of the Tuskegee Institute. The girls industrial building is known as the Dorothy Hall. Although a building of considerable size, it cost only about £3,000, being built by the students of the school in all its parts. The instruction embraces plain sewing ; (2) dressmaking, (3) millinery, (4) cooking, (5) laundering, (6) domestic training for girls, (7) mattress-making, (8) basketry ; while there are post-graduate courses for sewing, millinery, cooking, and hospital training for nurses. An indication of the several courses is given hereunder.

25. *Plain Sewing.*—Girls who know practically nothing about needlework are admitted into this division, and when they have completed the course are promoted to the dressmaking division.

The course of instruction is of three years' duration, and the following is a description of its details :—

First Year.—Threading needle and use of thimble. Practice work. Basting. Overhanding. Stitching, overcasting, gathering, putting in gussets. Herring-bone stitching on flannels. Patching, hemstitching, tucking and whipping, ruffles, chain stitching, feather stitching. Darning on cashmere. Slip and blind stitching, mending, darning. Making button-holes and eyelets.

Second Year.—Familiarity with first year's work necessary. Names of sewing machines and parts. How to clean, oil, and operate the machine. Attachments, uses. Machine stitches. Choice of material. Instruction in the use of national garment cutter. Cutting and making men's underwear, also white and negligee shirts. Taking measures, cutting white shirts by measure. Cutting, basting, stitching, and trimming underwear. Cutting and making plain cotton dresses.

26.

26. *Dressmaking.*—The dressmaking division has grown to be one of the most important for girls. The room is fitted with large tables for draughting, tracing, and cutting, and with sewing-machines, dress forms, mirrors, books of modes, and show-cases for finished work.

Applicants must have completed the course in plain sewing, or must pass an examination to prove their knowledge of hand and machine sewing, and their ability to make simple garments, before they are admitted to this division. The course of study, which is of three years duration, is as follows :—

First Year.—Choice of materials. Draughting and cutting foundation and outlining skirt measurement. Making, hanging, drapings, and trimming skirts. Talks on form, line and proportion in relation to draughting and trimming. Draughting, cutting and fitting plain basques, and general finish of these garments.

Second Year.—Draughting basques, sleeves, and accessories to the basques from measurement. Draughting basques with extra seams for stout figures. Cutting and fitting close and double-breasted garments. Cutting and matching striped, plaid and figured basques and skirts. Talks on form. including artistic and hygienic principles of dress. Talks on colour and textiles, as applied to dress. Advanced work in making complete dresses from different materials. Much of the time is devoted to practical work.

Third Year.—Cutting, fitting, and pressing. Practice in the use of colours. Talks on the manufacture of cloth. Draughting jackets of different styles ; making various styles of collars and pockets. Lining and finishing pockets. Draughting garments of every kind. Making and finishing garments of various kinds from different materials.

27. *Millinery.*—Regular fall, winter, and spring openings are held each year, and visitors are invited to inspect the work done by the students. Hats, bonnets, and fancy articles are made to order for teachers and outsiders.

The instruction in this division is divided into two graded courses, each covering a term of four months, the details of each being as follows :—

First Course.—Talks on colour and textiles. Instruction in choice of materials. Writing. Folds. Binding. Fitted facing ; full facing ; puffed edges. Varieties of bows. Talks on manufacture of straw and felt hats, and of ribbon. Talks on form and line. Principles applied to a hat of choice. Materials. Examination. Drawing : pencil practice—cylindrical objects. Drawing untrimmed hats. Drawing drapery, bows.

Second Course.—Instruction on colour, form, and line. Plain bonnets, covered, trimmed, and lined. Conversations on the manufacture of crape, and on the growth and manufacture of silk. Crape bonnet. Silk hat or bonnet making. Toque and turban making. Drawing trimmed hats and bonnets. Notes on form and colour. Practice in use of combinations of colour.

28. *Cooking.*—The Division of Cooking has two kitchens and two dining-rooms, well lighted and ventilated. The course extends over four years. The institution insists that ever girl attending the day school shall receive instructions in this department. Especial stress is laid upon cooking plain ordinary food.

The details of the course of instruction are as follows :—

First Year.—Making and care of fires. Care and adjustment of lamps used for cooking. Cleaning and keeping in order tables, closets, sinks, and pantries. Care of material as it comes from market. Washing kitchen and cooking dishes, and care of baking-bowls, dish-towels and dish-cloths. Cleaning painted and unpainted wood-work. Washing windows, sweeping and dusting. Utensils—proper use and care. Breads without yeast : biscuit, corn bread, sweet and white potato bread, Graham and oatmeal. Muffins of each of the above flours, and combinations of rice or grits with them. Pancakes in variety. Making different kinds of toast and using stale breads. Vegetables cooked in simple ways. Meats : simplest forms of cooking meats : making plain, brown, and milk gravies and sweet sauces. Cereals—cooking and serving in various ways ; also fish and eggs.

Second Year.—Care of silver, glass, china, brass and nickel. Care of table linen. Laying table for different meals, waiting, clearing table and washing dishes. Cleaning oiled floors. Lessons on providing material for meals, and calculating cost. Preparing given menus, and estimating time required in preparation. Making yeast bread, brown and white, rolls, muffins, coffee, spice, and raisin bread. Soup-making, with and without meat ; purees from beans, peas, and other vegetables with, or without milk. Stews, hashes, minces. Chicken : cleaning and cooking in various ways. Bacon : boiled, fried. Tea, chocolate, coffee, and cocoa.

Third Year.—Theory, foods, source, selection and composition. Economic value. Practice: Principles involved in different methods employed—(a) Boiling, steaming ; (b) broiling and roasting ; (c) frying ; (d) adaptability of different materials. Theory, foods : economic use, classification, practice. Proportion. Tables of average time required. Tables of average cost of material. Bread-making according to proficiency of pupils. Vegetables in attractive ways with sauces in scallops, croquets, salads, etc. Advanced lessons in soup-making with garnishes. Theory, foods, combination. Effects of cooking on digestion. Practice Plain pastry, pies and tarts, salads, meats, fish, vegetables, fruits and nuts. Simple desserts, hot and cold. Cakes with and without butter with fruit. "Cookies." Lectures from science of nutrition. Work with Aladdin oven. Work with charts and Atwater's tables.

Fourth Year.—Chemistry - Study of dietaries : 1st. Balancing rations of common food material. 2nd. Estimating cost. 3rd. Foods for children, invalids and infants. Study of yeast, mould, bacteria, ptomaines, etc. Practice in work room. Principal means of preserving foods ; drying, salting, canning, pickling, preserving, cold storage with illustrations. Arrangement of bills of fare : for daily living, three meals per day. For class-room : expense limited to fifty cents for each person. (a) Five food principles, plan, cook and serve. (b) Quantity and relative proportion of each needed. Dinner of three courses for six persons : 1st. To sustain life. 2nd. To sustain life with work margin : average ration ; lunch for tennis party. To sustain life with work margin and have a balance of reserve (maximum ration). For evening reception : practice cooking cakes, pastry. Salads and other advanced cooking according to orders. Review of first three years. Extra savories and entrees. Roasting, sauces, meats, fowl, game, jellies, marmalades, frozen sweets. Preparing and serving in class dining-room each meal of the day. Luncheon and evening collation to Director of Department and invited guests.

29. *Laundering.*—The art of washing and ironing according to improved methods is taught. Two washers, an extractor, a mangle, starcher, collar-and-cuff ironer have been added to lighten the drudgery. Drying rooms and ironing rooms provided with excellent facilities afford means for thorough teaching. All of the laundry of teachers and students, including bed and table linen, is done by this division. The course covers one school year, the details of which are the following :—

Water.—(a) Kinds—how known ; (b) uses known. Soap : (a) definition, (b) kinds, (c) why used. Alkalies : (a) kinds, (b) uses. Irons—kinds—uses. Washing : (a) preparation ; (b) how to wash flannels, linens, prints. Drying. Preparation for ironing. Miscellaneous work. Laundering laces, silks, etc. Recipes for making soaps, bleach, removing stains. Practice work. Review and examination. Studies in chemical analysis of bluing ; kinds. Starch—varieties. Acids : kinds, uses. Preservers of colour in fabrics. Machinery : (a) use, (b) care.

30. *Domestic Training for Girls.*—The home training given to students at Tuskegee is one of the most valuable parts of their training. It is the policy of the Institute to give special attention to the training of girls in all matters pertaining to dress, health, etiquette, physical culture, and general housekeeping. The girls are constantly under the strict and watchful care of the Lady Principal and the lady teachers. Special rules governing the conduct of the girls are made known to each girl upon her arrival. In addition to the general training, they receive special practical talks from various members of the faculty on such matters as relate to the care of the body, social purity, etc.

31. *The Parker Model Home.*—This is the home of the young ladies of the Senior Class. The building consists of eight large and beautifully-furnished rooms, intended for two occupants to the room; a laundry, pantry, kitchen and dining-room. The bed-rooms are furnished by the students. Only a small outlay of money is required to make these rooms very comfortable and attractive. Here the girls are taught to do by "doing;" the class as a whole being required to do actual work in the line of general housekeeping, cooking and serving of food, and laundering.

The course has been developed in the following manner :—

The Home.—Location, sanitation. Furniture: purchasing, arrangement, proper care. Surroundings, advantages. Cleaning: when and how. Lamps, beds, bed-rooms. General weekly cleaning, scrubbing. Care of dining-room: table, serving, linen, silver, pantry, dishes and towels. Duties and manners of hostess. Kitchen: furnishings, care. Marketing, economy, punctuality and regularity in preparation of food. The sick room: (a) attractions, (b) ventilation. Changing of patient's clothing and bedding. Feeding, visiting the sick. Yards and outhouses: how to keep clean and how to beautify. Visiting: when, how and whom to receive. Housekeeper: personal appearance. Dress: what to wear, colours suitable. As far as possible all the lessons have a practical application.

Practice House.—In order to give practical demonstrations in home-keeping and to develope the sense of responsibility in the work, a four-room house has been set aside, in which the senior girls "keep house." Four girls at a time live in this house and have the entire care of it. They do all the work that pertains to ordinary housekeeping, from the Monday morning's washing to Saturday's preparation for Sunday. They are also charged with the responsibility of purchasing the food supplies which they consume. Two dollars and a half is allowed for the weekly expenditure in food. In view of the low prices that obtain for provisions here, four girls can live comfortably on this small allowance and have variety and plenty, and at the same time very wholesome food. Thus, the lesson of economy is taught in the most effective way. *The girls learn to appreciate the purchasing power of money—a kind of training which boarding students, who have so much done for them, do not get.*

They acquire the habit of evolving their own plans; of exercising unhampered, their own tastes. Regularity, system, exactness, neatness, and the feeling of responsibility, are all developed by the system.

32. *Mattress-making.*—In connection with the course, the theory of the process of caning and upholstering is taught by talks or by assigned reading. The course covers two years, and is as follows :—

First Year.—Repairing, covering, cutting, preparing materials for mattresses, making comforts. Making mattresses and pillows, cording, boxing, fitting. Beginning chair caning on frames. Drawings. Individual patterns for chair bottoms, designed from studies. Estimates of cost of different materials used for window seats in upholstering. Measurements. Cutting and making.

Second Year.—Studies in designing for caning and making chairs. Practice work. Upholstering. Box couches. Hassocks. Window seats. Test work in designing and making articles manufactured in this division. Written reports on past work, with special reference to present day practice.

33. *Basketry.*—This course covers four years, and is intended to teach a girl to weave and twist native grasses, the palm, pine-needles, twigs, etc., into beautiful and useful forms. It fills the need of a practical and material home industry. The following are the details of the course :—

First Year.—Study of material. Knife work in thin wood. Models; flowers, sticks, etc. Study of tools, simple. Working drawings. Constructive work in wood—box, square joint, shelf-work box, etc. Wood-working. Practical application. Implements for school and home use.

Second Year.—Material, native. Gathering and preparation. Study of form and combinations. Brading. Twisting. Sewing. Knotting. Practice in simple forms.

Third Year.—Combination of forms. Practice work in the forms (type). Combination of materials. Studies of ancient and mediæval designs. Theory of basketry. Individual designs from nature. Scroll and decorative work.

Fourth Year.—Review of forms and designs. Decorative Art. Combination of colours. Harmony in materials by constructive work. Comparison of ancient and modern basketry. Combination of these forms. Constructive art: developed. Practice teaching. Practical work in making and repairing cotton baskets, hampers, etc.

34. *Post-graduate Courses for Girls.*—The sewing, millinery, and cooking courses have already been referred to. The first includes costume design, involving sketching, study of the human form, and the designing of gowns. Art needlework is also taught.

Under the second head are studied, drawing, water-colour designing, design of drapery, bows, and hats, the outline and proportions of the human head, adaptation of different styles to the face, the study of historic hat-wear, and the designing of hats.

The cooking includes the laboratory work, composition and analysis of food, and a critical study is made of twelve typical foods. Food economics are also studied.

35. *Hospital and Training School for Nurses.*—The facilities for nurse training are excellent and the standard of admission high. Nurses have regular periods in the drug-room, after beginning the course in Materia Medica, which enables them to get a practical idea of the character and compounding of drugs. Graduates from the hospital are doing good work, many having excellent positions in the hospitals, schools, and private infirmaries throughout the South. The five nurses the institution sent to the Spanish-American war were the only coloured female nurses employed by the Government. The course of study covers three years, but is so arranged that those who are able can complete it in two. The donor of the Hospital Building has agreed to furnish it with the best apparatus now in use in first-class hospitals. The following is an indication of the course of study :—

First Year.—Deportment of nurse in hospital and family. Qualifications and relations of nurse to patient, doctor, and family. Wards, care, ventilation: model sick room. Beds: care and making. Handling bed patients. Contagion, disinfection, etc. Dietetics: lectures in domestic chemistry. Twenty-two lectures on anatomy and physiology, including names of bones, injuries, articulations, muscles, blood, with its histology. Nervous system, vital organs, intestinal tract, skin, etc. Regular recitations come before and after each lecture.

Second

Second Year.—Dietetics; three months, with practice in preparation of diets. Local applications, disposal of excreta, enemas, rectal alimentation, hypodermic injection, mechanical appliances. Baths: kinds and effects. Making and keeping charts (fever and symptoms). Materia Medica: Twelve lectures, with three months' practice in drug-room; testing and illustrating drugs of everyday use, and compounding simple prescriptions. Symbols and weights, both metric and apothecaries'; Surgery: Twelve lectures, including germ life, wounds and healing solutions, bandages and bandaging, dressing fractures, sprains, and dislocations. The operating-room; preparation of patient, instruments, care during operation, anæsthetics. (All surgical material is made by nurses.) *Medical Lectures*: Fifteen lectures, including the principal diseases, examination of urine, the excretory organs, use of catheter.

Third Year.—Midwifery: Twelve lectures; practice in ward and city. Diseases of children: Six lectures, including the contagious diseases of childhood, methods of feeding infants and sick children. Diseases of women: Five lectures, including douches, positions, local medication, and baths. Massage, practical demonstrations. General review, three months, including hospital management and practical teaching.

36. *Agricultural Department.*—The Agricultural Department has courses for young women, and also for young men, and includes dairying, market gardening, practical agriculture, stock-raising, bee-culture, horticulture, and work on an agricultural experiment station.

A part of Tuskegee's method of education has been to prepare young men, by actual work on the school farm, in raising food supplies, caring for stock, fruit, and all useful products, so as to become intelligent and successful farmers. In 1897 a splendid modern building, the Slater-Armstrong Memorial agricultural building, costing about £2,000,[1] was built and equipped for teaching both practical and scientific agriculture. During the past year two wings were added to the building, at a cost of £1,000.[1] Room for adequate laboratory and museum is thus provided. Under the direction of the head of this department work is carried on in the laboratory and in the field. The laboratory work is simple and easily understood by the students. It consists, in the main, of analyses of the various soils, for the purpose of learning what elements need be supplied in order to make them more productive. This enables the students to make a proper selection of fertilisers. Fertilisers are also tested to find their composition. Feeds are tested to find those best adapted to the production of fat, milk, or muscle There is also practical analysis of all dairy products -milk, butter and cheese, and a comprehensive study of foreign and native forage plants. All the scientific knowledge is carried daily into the fields and into the practical work of the various divisions of the department. In this way the technical knowledge of the laboratory is worked out in the fields and in the products of the dairy, garden, and orchard. From fifty to seventy-five cows are milked in the Dairy Division. The milk from these cows is used to prove the experiments of the laboratory, and also supplied to teachers and students as milk and butter in the Students' and Teachers' Home Departments.

The orchard and truck garden are also used for practical results. Budding, grafting, trimming, and the care of plants and trees are taught always with a view of supplying fruit and vegetables for the school. Some splendid results have come from the Agricultural Department, and are set forth in bulletins issued by the Experiment Station.

The institution owns 2,500 acres of land, of which 1,500 acres are divided into two farms, known as the Home Farm and Marshall Farm. The Home Farm is used to raise vegetables, fruit, poultry, cows, hogs, and horses. The Marshall Farm is 3 miles from the school, and contains 800 acres of land. Upon it are raised mainly heavy grain, potatoes, sugar-cane, peas, etc., to supply the boarding department of the school. Vegetables are also raised in great abundance upon it. This farm is cultivated entirely by students. A night school is carried on at the Marshall Farm eleven months in the year.

There has been added to this Department work in dairying, poultry-raising, horticulture, and floriculture for girls. The experiment has been tried the past two years with excellent results. A large majority of the young women who came to Tuskegee are the daughters of coloured farmers, living on small plantations. But such people get little benefit from their gardens, as travellers through the country districts of the Southern States know. With every advantage of soil and climate, and with a steady market, if they live near any city or large town, few coloured farmers get any benefit from this, one of the most profitable of all industries; and the Institute aims at changing all this. The girls in the various agricultural divisions have as careful training as do those in any of the other industries, sciences, and arts taught here. This work is carried on in connection with the regular work. The special object in view is to fit girls for earning a pleasant and profitable living in lines offering rich rewards to the industrious. It is believed that this experiment, in its ultimate development, will prove one of the most successful features of the work of the school. When satisfactorily completed, certificates will be issued from these divisions. The courses for girls are as follows:—

37. *Agricultural Courses for Girls.*—These courses are organised as shewn in the programme given hereunder:—

FIRST YEAR.

Fall Term.

Dairying.—The home dairy is first taken up, and a clear knowledge of the following points obtained:—Kind, use, and care of utensils, gravity creaming; a study of stone, wooden, and tin churns; ripening of cream, churning, working, and salting butter; preparation and marketing of same; feeding and care of dairy cows.

Poultry-raising.—A working knowledge of the following points is here required:—The economic value of poultry on the farm, pure and mixed breeds, plain poultry house construction, making of yards, nests, and runs. A generous Northern friend has placed £200 at our disposal for the development of this industry. A new building has been erected for the special use of the Division of Poultry-raising.

Horticulture.—Instruction is given as to the importance of an orchard and small fruits, varieties best suited; particular locality, selection and preparation of ground; setting; trimming; extermination of borers, lice, scull, etc.; especial stress being laid upon the quality and quantity of peaches, pears, apples, plums, figs, grapes, and strawberries that should be planted in a home orchard.

Floriculture and Landscape Gardening.—A study of our common door-yards, the laying out and beautifying of same, etc., is required. The kinds, care and use of tools used in floriculture and landscape gardening. Trimming and shaping of beds and borders, and the general care of shrubbery and flowers. The gathering and saving of seed. Special treatment of rose-bushes and shrubbery.

Market Gardening.—Much stress is here laid upon the management of the home garden, its value to the home, selection and preparation of ground; kinds, care and use of tools; planting; gardening and marketing of fall vegetables. Gathering of seeds, drying pumpkins, cushaw, okra, and fruits.

Live Stock.—Study is limited wholly to ordinary farm animals, the number and kind needed, how, when, and where to feed; characteristics and utility of the various animals.

Winter

[1] It must be remembered that the students assist in or wholly carry out the work of building. Its real value is very much more than this.

Winter Term.

Dairying.—The commercial dairy is the subject of study, and the following points are emphasised:—Use of separators, of which the school has two leading styles; churns; feeding and care of the dairy herd, breeds of dairy cattle and their selection, butter-making, packing, salting, and preparing for market.

Poultry-raising.—Special study of breeding and feeding. When, how, and what kind of eggs, and the breed of fowls to set: the period of incubation, poultry book-keeping; saving of eggs for market; an introductory study of young chickens.

Floriculture and Landscape Gardening.—Trimming of beds and borders, mulching, tying, wrapping and preparation of plants for winter. Winter decoration of grounds; the decorative value of native shrubbery; a study of window plants, their value in the home, halls and public buildings; their economic value, etc.

Market Gardening.—The selection of grounds and making of hot-beds, cold frames, etc.; planting and managing of same; the raising of winter vegetables, marketing.

Spring Term.

Dairying.—Milking; a study of pastures; how to destroy lice and other parasites; the care of calves; the utilisation of waste in the dairy; laboratory work.

Poultry-raising.—A more advanced study of young poultry, brooders, sanitation of the house, runs and of all the apparatus; egg-testing; moulting, and its effects upon different breeds.

Horticulture.—Spring planting, trimming, budding, grafting, spraying, care of grape vines, the wire-and-post system of supports; spring layerings and cuttings.

Floriculture and Landscape Gardening.—Renewing of beds and borders, seed-sowing; special study of propagation by layers, cuttings, division of roots, bulbs, etc.; kinds and uses of fertilisers for this special season.

Market Gardening.—Preparation of ground, what and how to plant; special stress being laid upon the production of early vegetables for the home and market. Reproduction of plants by seeds and by division of numbers; water and its office in plant economy.

Live Stock.—Includes the history, development, characteristics, standard points, utility, adaptability to climatic conditions; lessons on judging, care, selection and management of the leading breeds of horses, sheep, and hogs.

SECOND YEAR.

Fall Term.

Dairying.—A more comprehensive study of milk and its constituents; weeds and their harmful effects upon dairy products; general sanitation of dairy barns. the drawing of plans, etc.

Poultry-raising.—Insecticides, how to make, when and how much to use; diseases of fowls and their treatment. A study of foods and their adaptability to different breeds; special study of turkeys and guineas.

Horticulture.—Root and stem grafting with active and dormant buds; formation of trunk and top starch, and its relation to the hardiness of fruits and shrubs; botany of the orchard; entomology; book-keeping.

Floriculture and Landscape Gardening.—Systematic botany, bouquet-making, harmony of colour, form and size of flowers, laying-out of private and public grounds, roads, parks, walks, and streets; entomology of the flower garden.

Market Gardening.—Botany of the field and garden, physical analysis of soils, and the improvement of clay and sandy soils, the depletion of plant food, and its replacement by direct and indirect fertilisers, the source of carbon, nitrogen, and oxygen. Drainage.

Live Stock.—How to hitch and unhitch horses, the care of vehicles and harness; how to drive; the names of common diseases and treatment of sick animals; swine for profit.

Winter Term.

Dairying.—The weighing and recording of milk in a commercial dairy; the Babcock and other methods of testing milk; composition of cheese and its value as a food.

Poultry-raising.—Composition of the animal body; a special study of ducks and geese; brooders, ponds, runs, etc.; by-products and their value.

Horticulture.—Forestry, botany, cryptogamic and systematic nut-culture; preservation of timber, the economic value of different woods; the relation of forests to climate, water supply, floods, erosion.

Floriculture and Landscape Gardening.—A more advanced study in the harmony of arrangement, planting, etc.; plain designing with native material only, special stress being laid upon decorations most suitable for funerals, carnivals, the making of bouquets for same, and all kinds of public and private gatherings. Bee-culture, preparation of hives for the winter, feeding, etc.

Market Gardening.—A study of the life-history of insects, injuries to stored grain, peas, beans, meal, flour, dried fruits; botany of the greenhouse, cold frame and hot-beds; the use of thermometers. A study of markets, library work.

Spring Term.

Dairying.—Cottage and Cheddar cheese making, scoring of butter, bacteriology of milk, butter, and cheese. Judging of dairy animals by the score-card method; diseases of cows and their treatment; analysis of food stuffs.

Poultry-raising.—Physical and chemical study of foods, library work, fancy breeds, what and how to exhibit, the history and development of the industry. Heredity and the effects of inbreeding.

Horticulture.—Origin of new varieties by cross-fertilisation, hybrids, sports, atavism and reversion, correlation between plants and animals, rejuvenating by pruning, grafting, and scraping the bark; special diseases of both trees and fruit, and their treatment. Knot growth, blight, gum excrescences, and frost injuries; drying, preserving, making fruit syrups, etc.

Floriculture and Landscape Gardening.—Special designing in cultivated flowers. Origin of new species; bees and their relation to the forest and garden; the hiving of bees and after-management. A study of honey-producing plants; the economic value of honey.

Market Gardening.—Relation of crops, geology of the garden, agricultural chemistry; good roads and their relation to the success and value of the farm; mineralogy and useful birds and insects.

38. *Agricultural Courses for Young Men.*—The agricultural courses for men are developed as follows:—

FIRST YEAR.

Fall Term.

English language. Live stock. Market gardening. Horticulture.

Winter Term.

Economic entomology. Practical agriculture. Botany, dairying, market gardening, live stock.

Spring Term.

Bacteriology and vegetable physiology. Laboratory practice. Practical agriculture. English. Live stock. Horticulture. Dairying. Market gardening.

SECOND

SECOND YEAR.

Fall Term.

Botany, cryptogramic. Laboratory practice. Practical agriculture. Agricultural chemistry. Horticulture. Principles of heredity. Dairying. Seeds and grasses. Market gardening.

Winter Term.

Applied botany. Laboratory practice. Live stock. Botany and bacteriology. Practical agriculture. Dairying, Horticulture. Practical agriculture. Drainage.

Spring Term.

Bacteriology of milk. Practical agriculture. Agricultural chemistry. Laboratory practice. Horticulture. Vegetable pathology. Dairying. Animal nutrition. Market gardening. Live stock.

In treating of live stock, the history, development, characteristics, standard points, utility, resemblances and differences, acclimatisation and adaptability, judging, care, selection, and management of the leading breeds of horses, cattle, sheep, and hogs are dealt with. Breeding is treated as an art, and heredity, atavism and reversion, laws of correlation, variation, and fecundity, influence of parents on previous breeding, sex, pedigree, form, selection, and period of gestation, are discussed.

Practical agriculture includes all questions of the growth of crops, their rotation, minerals which are important in plant economy, harvesting, ensilage, irrigation, sewage, pasturing, fields, systematic observation.

The practical effect of drainage, of lands which specially need it, the importance of preliminary and topographical survey, the various problems of drainage and engineering connected therewith, map-drawing, the mode of calculating depth of drainage and capacity of pipes, of laying and preserving drains, are all treated.

A comprehensive study of a large number of native and foreign plants that have been introduced is made, so that they may be identified and the student familiarised with the seeds which form the basis of adulteration in forage crops.

39. *Dairying*—Aside from the scientific work in the dairy, each student is required to master the following points:—

First Year—

1. The cleaning and ventilating of dairy barns, six weeks. Grooming and bedding of cows.
2. Milking and recording the same, six weeks. Feeding and care of cows and calves, eight weeks.
3. Destruction of ticks, lice, etc., eight weeks. Pasturing, six weeks.

Second Year—

1. Individual study of different breeds in the dairy herd, eight weeks. Breeding and feeding, eight weeks.
2. Treatment when sick, four weeks. Special study of cooked and uncooked food, four weeks. Special study of dairy machinery, feed-cutters, grinders, and steam power, four weeks.
3. Dairy possibilities of the state, six weeks. Dairy barns and co-operative dairies. Special study of dairy business methods.

40. *Market Gardening*—This course of study is of two years' duration, the details thereof being as follows:—

First Year—

1. Kinds and care of tools, ploughing, spading, and preparation of seed-beds, six weeks.
2. Construction and care of hot-beds, six weeks.
3. Planting, transplanting, twenty weeks. Intensive cultivation, eight weeks.

Second Year—

1. Growing vegetables in winter, twenty weeks.
2. Care and preparation of vegetables for market, twelve weeks.
3. Preservation of root crops, and cold storage, eight weeks.

41. *Practical Agriculture.*—The course in practical agriculture is as follows:—

1. Kinds, care and uses of tools and instruments, ten weeks.
2. Preparation of sand, loam, clay, and peaty soils, five weeks.
3. Testing seeds: time and depth of planting, six weeks.
4. Transplanting by hand and other methods; cultivation, six weeks.
5. Destruction of insects and fungus; diseases; use of improved machinery.
6. Fence-building; harvesting, housing, and rotation of crops, farm economics, five weeks.

42. *Stock-raising.*—Practical instruction is given along lines already indicated, its duration being twelve weeks. In addition the following courses are given, viz.:—

First Year—

1. Feeding, breeding, grooming, and treatment while sick; sixteen weeks.
2. Harness: kinds, care and use; eight weeks.

Second Year—

1. Instruction in stock-breeding, sixteen weeks.
2. Vehicles: kinds, care and use; eight weeks.
3. Butchering, twelve weeks, including a study of beef, mutton, and pork breeds especially adapted to the South; cutting and preparing for market.

43. *Bee-culture.*—The climate of Alabama is a favourable one for apiculture. An apiary of 100 colonies has been collected. The success so far has been satisfactory, and it is expected to prove profitable as well as instructive.

44.

44. *Horticulture.*—All students of the Agricultural Department are required to acquaint themselves thoroughly with the following features of agriculture :—

First Year—

1. Kinds, care and uses of tools ; six weeks. The importance of fruit culture ; six weeks.
2. Special attention is given to the following fruits : Apples, pears, quinces, figs, grapes, plums, peaches, cherries, strawberries, gooseberries, blackberries, etc. ; fourteen weeks.
3. Deciduous, evergreen, and ornamental trees, and their importance for shelter-belts. Special attention is given to the value of native material. Fourteen weeks.

Second Year—

1. Laying off parks and private grounds, walks, streets, and pruning ; twelve weeks.
3. Orchard gardening and forestry ; twelve weeks.
3. Budding, grafting, layering, inarching, cross-fertilisation, hybrids, sports, and special direction for packing, marketing, and general care of fruits, etc. ; sixteen weeks.
4. Library work includes the classification of a library ; the making of important digests, and abstracts from important books, bulletins, and papers.

45. *Agricultural Experimental Station.*—This station has been established in connection with the institution. The station staff is composed of the Director and Instructors of the Agricultural Department of the Institute. It has a subsidy of about £300 per annum, and carries out such experiments in scientific agriculture as are calculated to advance its interests. Chemical analyses are made, and these may be undertaken by the chemists of the Agricultual Department under the supervision of the "Commissioner of Agriculture." The subsidy is intended to maintain and provide for the actual operations in the Experimental Stations, with the express object of educating and training coloured students in scientific agriculture.

46. *Concluding Remarks on the Tuskegee Institute.*—In its way the Tuskegee Institute is unique. It provides an ideally practical education. It teaches its students to study, to live, and to work, in such a way as to combine all the elements of a true industrial education. It does not aim at turning out graduates in the highest branches of technical education, that is not its mission, but it meets a pressing want of the coloured community. Their work is immediately practical and productive. Those engaged in the building trades see the finished buildings as the monuments of their industry, and similarly through all departments.

The principal, Mr. Booker T. Washington, is the genius of the institution, and it is owing to his organising faculty, and to the tone which he has inspired, that the success has been so remarkable. The work of the institute has demonstrated what has always been contended by educationists, viz., that *the building up of character is of fundamental importance.* The whole effort is instinct with earnestness of purpose, thoroughness, and practical power.[1]

---

[1] The indication given of the courses is fairly complete for a brief sketch. Reference should be made to the official catalogue for fuller information.

CHAPTER XXI.

CHAPTER XXI.

Manual Training Schools of America (Eastern States).

[J. W. TURNER.]

Introduction.—The system of manual training in the primary schools of America is on a properly co-ordinated plan, and, as practically followed out, is the logical and natural sequence of the Kindergarten. It is not necessary here to refer further to manual training in elementary schools. This phase of the question was fully treated in the Interim Report, especially in the experiences related in connection with the Higher Grade Schools of Great Britain, the Upper Primary Schools of France, the Grammar Schools of the United States, and the Public Schools of Canada. The work is continued in the High Schools of America, and in towns of any size the Manual Training High School is an institution of equal importance with the academic school. The State of Massachusetts, always in the van in matters pertaining to education, was the first to recognise the importance of manual training in the high school curriculum. Ten years ago, a law was passed in the State Legislature, mainly through the efforts of Frank Hill, Esq., Secretary to the State Board of Education, one of the foremost educationalists of the world, requiring every city and town of 20,000 people and over to maintain manual training as part of its high school system, and in 1898, a clause was added requiring such communities to provide for this training in the primary schools also. The readiness and willingness of American people to support what is for the good of their children are exemplified in a Report of the Massachusetts State Board (1899), which showed that not only had the law been complied with but that a number of towns with populations under 2,000, who were not affected by the law, had voluntarily provided for Manual Training High Schools.

Views of a Canadian Expert.

In the Report of John Seath, Esq., B.A., High School Inspector, Ontario, on manual training schools of the United States, with suggestions as to changes in the courses of study in the High Schools of Ontario, the following passage occurs, and as it is pertinent to the question under review, it is reprinted:—

"All this (the introduction and maintenance of the manual training high school) has not been accomplished without much effort and a large expenditure of public money, especially in the high schools. Local sentiment, however, still varies from strong advocacy to antagonism, and, although in Massachusetts the general feeling has expressed itself in legislation as being favourable, the work of educating the people has still to go on even in this enlightened Commonwealth. It is well to note here that, while the labour unions still look askance upon trade schools, they are invariably favourable to manual training. As an illustration, I may record the fact that the last Annual Report of the Illinois Bureau of Labour Statistics recommends the passage of a law favouring the compulsory establishment of Kindergartens in towns of 5,000 inhabitants or over. In cities of over 20,000 people it recommends manual training schools, and also suggests that provision be made for the training of Kindergarten and manual training teachers in all the State Normal Schools. A bill based on these recommendations and including domestic art, has just been introduced into the Legislatures. Still further, under date of 24th January, I find that the Building Trades Council and the Bricklayers' Labour Union of Chicago, have petitioned the Board of Education to have their apprentices take technical training at the English High and Manual Training School of that city. This is also suggestive to Ontario."

The same writer in his Report quotes some very reliable opinions on the question of the relation of the manual training school in the United States to the higher technical institutions. The opinions are as follow:—

"*Opinions of Universities and other Authorities.*

"On the question of the relation of the manual training schools in the United States to the higher technical institutions, I am able to submit the following opinions:—

"From the Secretary of the Massachusetts Institute of Technology, Boston:—

"I am inclined to answer your question as to preparation in manual training schools as follows: In the first place, a manual training school attracts and holds a considerable portion of boys who would have abandoned the ordinary academic high school course to go into practical work without ever completing preparation for admission to the Institute. The Mechanic Arts High School in Boston thus sends us at present more applicants than any other school, while the number coming from the English High School has fallen off very considerably. These boys include a large proportion from the industrial and even the poorer classes, increasing incidentally the demand for scholarship aid. In the second place, the value of their preparation for our work depends much on the quality of the boy, and much, of course, on the quality of the teaching, apart from the abstract merits of the kind of education itself. The boys who come to us from the manual training schools are to some extent those whose particular mechanical instincts were at the outset relatively strong. These boys, when they come to us, are, therefore, likely to be one-sided, and to show weakness, or even to fail in our literary requirements, which are considerable during the first three years. In the third place, the direct anticipation of our drawing and shop-work in the manual training school is an advantage of varying importance. The work can rarely be so well done as by our own students, in the shorter time which the latter give to it. The drawing is required in all our courses, but shop-work is required only in particular ones in varying amounts.

"On

"On the whole, I am disposed to advise that a boy should choose between the manual training and other secondary schools on other grounds than their supposed merits as preparatory schools, and to consider them in this respect as of about equal strength, assuming, of course, that the academic preparatory course will include some study of natural and physical science, without which any secondary course seems to me to be defective.

"Is is doubtless an advantage, from our point of view, that our students should have had training in drawing and shop-work at an early age. It does not follow that in a particular case this training may have been the best.

"Professor Schwamb suggests that I add that the shop-work of our students can be done in less time and more thoroughly, partly because the men are more mature, but mainly because of their training in exact work in other laboratories of the Institute. He adds that previous training in shop-work and drawing is of particular advantage to students in certain other engineering courses—for example civil engineering—which do not include it in their actual requirements."

"From President Hadley, of Yale :—

"We have not as yet been able so to arrange our examinations that manual training can be made a part of them; and as we admit only on examination, and not on certificate, this has prevented us from incorporating it in the requirements for admission.

"I may, however, add that the work done by those who have had courses in good manual training schools has been of such high character that we are most favourably impressed with its value in secondary education."

"From the Secretary of the Faculty of Mechanical Engineering, Cornell :—

"We do not directly recognise manual training in our matriculation. After the students have entered upon the work of the course, if they are able to show the necessary skill, we allow them to make a certain number of exercises standing as an examination, and these, if up to the standard, may be accepted in place of the term's work. In this manner, if the student has gained sufficient training at the high school, he may be able to make it count in the university. Our experience has been, however, so far, that comparatively few students with only high school manual training are able to pass up very much of the work Neither do we find that at the end of the four years' course the man who has had high school manual training is likely to be in advance of his fellow who has not had such training. In other words, we find that the condition of the student at the end of his course will depend more upon the manner in which he has utilised the advantages which we provide than upon whether or not he has had previous training in the high school. I think that I may fairly say that for purposes of university preparation we do not place any great value upon high school manual training. We are quite content that the student should come without such training, and believe that for our purposes the time might be better spent in thorough training in the elementary subjects required for entrance. It does not follow that high school manual training has no value. It is a fact, of course, that but a small percentage of high school students finally reach the university and take a full university course. For the great majority who go from the high school into the world it may well be that they would find a course of manual training of great value; but I am convinced that if manual training in the high school has to be justified it must be by reason of its value for this class of students rather than for the one who goes on to take a university technical course."

Mr. Seath points out that Harvard University recognises the manual training system in its requirements for admission to its Department of Applied Science. The chief value of manual training, as he understood it, after discussing the subject with some of the Harvard authorities, seems to be in the education of young men who need to have their interest stimulated by manual exercises. Such training is also held to have an important place in providing the large number of young men who are employed in the smaller trades to be found about every large city. The system (Mr. Seath states), has not been long enough in operation at Harvard to justify any general conclusion in regard to its desirability as a preparation for college work; and with regard to its introduction into his own country, he remarks that the situation in the United States would not justify his people in making any immediate provision for preparatory courses in manual training for their University faculties of Applied Science.

The Status of the Manual Training High Schools of America.

Manual Training High Schools exist in all the large towns and cities of the United States, and are as much a part of the State Educational System as the English and Latin High Schools. They vary in numbers from one in the smaller towns to as many as twelve in such cities as Boston and Chicago. They are under the control of the local Boards of Education, as a rule. They are institutions altogether independent of the other High Schools of the city; their equipment is very fine, and education in them, as in all the schools of the United States, is free to local children. The Manual Training High Schools are frequently designated as Mechanics Art Schools, because they have specially provided for courses developing the principles of the Mechanic Arts. The principal Boston School, which cost $300,000, is known as the Boston Mechanic Arts High School. Springfield, Massachusetts, in addition to a splendid Academic High School, supports a very superior Mechanic Arts High School. The Boardman Manual Training High School, New Haven, is the gift of a wealthy widow, who donated $70,000 for a building, the City Board of Education furnishing the land and the equipment, and defraying the current expenses.

Admission.

Admission to the Manual Training High Schools is the same as that required for other high schools, viz., the certificate that indicates that a pupil has passed through Grade VIII of the Grammar School.

Courses in Training Manual High Schools.

The schools in the various towns and cities have much in common in their courses, individualising according to the demands of the community. Courses in English, Mathematics, Science, French, are universal; German is frequently found on the programme; Spanish occasionally. All of the schools offer in addition what are called "General Courses," such as drawing, workshop instruction, intended for those who are seeking a general education, and as a preparatory training for entrance into the higher school of Technology. Certain manual training schools provide courses for girls in Art and in Domestic Science and Art, while others provide Commercial Courses also. In Philadelphia there is a special Commercial High School attended by about 1,000 girls; but this branch of instruction is usually provided for in the English High Schools. (*Vide* Detroit Central High School.) In some of the schools the courses are for either three or four years. In Philadelphia there is a post graduate course in the Languages, History, Mathematics, and Science.

Courses

Courses in Manual Training Departments.

Several of the Academic High Schools of the United States, the English and Latin High Schools as they are designated, are provided with a manual training department. Work in both wood and iron is taken in some of these schools for boys, and clay-modelling, carving in wood, and joinery for girls.

The courses in the Manual Training Department of the High School, Lynn, near Boston, embrace work in both wood and iron. The course in shop-work is a three years' one, and comprises the following:—

First year.—Joinery, 28 weeks; wood-turning, 12 weeks.
Second year.—Wood-turning and pattern-making, 23 weeks; cabinet-making, 5 weeks; forging, 12 weeks.
Third year.—Tool-making, tempering, compounding of metals and alloys, moulding and casting, 16 weeks; chipping, filing, and machine work, 24 weeks.

Drawing is closely correlated with the shop-work.

Mr. Seath, who was particularly interested in this department of the High Schools, Lynn, points out that in the instruction attention is given to such parts of the forestry as could be taken in connection with the course in wood. He observes a peculiarity in the school in the fact that the teachers of manual training take a share in the academic work in the high school proper in English and mathematics. On the question of the real value of these schools, whether educational or economic, Mr. Seath's views, which are given here in full, are invaluable to us:—

"As I have already said, these schools are not regarded as trade schools either by their staffs or by the public, and I seldom heard the education they give described as technical. Both terms seem to be studiously avoided in this connection. It is always held that the schools have as much claim to be considered educational as have the English or the Latin High Schools. They specialise in manual training; the English and the Latin schools, in English and the languages. Indeed, it is maintained that the Manual Training Schools are more important educationally than are the other two classes of High Schools, for they educate the whole nature, the creative as well as the acquisitive powers. It is not, however, denied that in the later years of the work, the courses are a direct preparation for the industrial pursuits; but it is pointed out that the courses in the other schools are a direct preparation for the professions, and that the industrial arts have at least an equal right to consideration. Some of the Manual Training Schools, as, for example, those in Providence and New Haven, may fairly be described as lower grade Technical Schools; they emphasise the industrial aspect more than some of the others. Such schools supply a demand which the decline of the apprentice system and the marvellous progress of industry have of late years developed in the United States for technical training of a grade below that of the Schools of Technology. They prepare young men whose funds and time are limited, for positions as designers, draughtsmen, and superior workmen, many of whom eventually become foremen and managers; and, with the education they give, a man of ability may rise to any position in industrial life: not all a man's education is obtained at school or at college. It is, I should think, exceedingly probable that the Manual Training High School idea will develop more and more in this direction, especially in the smaller cities, where limited financial support will prevent a more complete subdivision of educational labour.

"An examination of the records of 700 or more of one of these institutions shows that 70 per cent. of its former students are engaged in pursuits in which what is required is a high order of intelligence, with skill of hand in dealing with force and matter. Already a large number occupy positions of trust and responsibility as superintendents, managers, and foremen. That such schools also foster a desire for higher learning is shown by the fact that 20 per cent. of the graduates become students in the colleges, universities, and higher technical schools. On another point, emphasis was laid by all the principals I saw; many of the students go into kindred commercial occupations (hardware stores, &c.), or become dentists, doctors, or lawyers. These, I am told, bear witness to the great advantage from hand and eye training and a general acquaintance with industrial pursuits. The resulting sympathy with and respect for labour are also not the least of the recommendations of such courses for those whose occupations are of a more literary character.

"The flexibility of the American system—its adaptability to local needs—is seen everywhere. In Springfield, for example, I found, in connection with the Mechanic Arts High School, evening trades classes in tool-making and plumbing. These classes were at first very successful; but, owing to the withdrawal of the city appropriation, a fee had to be charged and the attendance at once fell off. At present only the class in plumbing survives. It is also significant of the liberality and intelligence of the American workmen in Springfield, which is a distinctively manufacturing city, that its Plumbers' Association have voluntarily agreed, in employing help, to give the preference to members of the evening classes in plumbing. Speaking of these classes in his report for 1899, Mr. Thos. M. Balliet, the city superintendent, uses words which show clearly the direction in which the manual training idea is drifting in some parts of the United States:—

"The success of these classes makes it clear that if provision were made for the teaching of several trades in the day high school, in the Manual Training course, it would meet with wide popular approval; and it would provide a kind of high school education for boys who ordinarily are obliged to go to work when they have completed the grammar school course, and are thus deprived entirely of a high school education. The present equipment and teaching force, both of which have been increased the present month to provide for the needs of the school as now organised, would also be sufficient to teach machine-shop practice, pattern-making, and joinery as trades. The adding of other trades would, at this time, involve more or less additional expense."

Central Manual Training School, Philadelphia.

Introduction.—The Chairman of the Board of Public Education, Philadelphia, in presenting his seventeenth annual report, in 1902, on this school, made the following remarks:—"The institution has achieved the reputation of being one of the best exponents of the modern educational movement. The manual training school was the logical outcome of a demand for that kind of training by which young men could be put in closer touch with the needs of the present day. The inadequacy of the ordinary high school methods in preparing boys for life's problems was keenly felt long before the educational value of tool instruction was known. The opening up of new fields of employment by the development of new improvements, the immense strides in the modes of travel, the rapidity of the transmission of news,

news, the revolutionising of the methods of the manufacture by improved machinery, the various uses to which electricity alone could be put, called for a class of young men, educated not only along academic lines, but who were also trained to put ideas into concrete results. It was felt that, if useful men were needed, useful means should be employed for their training. 'To bring thought and labour together; to make the thinker a worker and the worker a thinker' was the problem to be solved by the founders of the movement, and the results have jully justified the wisdom of the experiment."

Aims.

Speaking of this school in particular, the Chairman said:—" This school affords an opportunity for its students to pursue the usual high school course in literature, science and mathematics, and at the same time to receive a thorough course in drawing and in the use and application of tools."

Addressing himself to the real aims of the school, the Chairman remarked that the object of a manual training school is the education of all faculties, and not the training of any special group. The boy is trained æsthetically, mentally, and physically. It is meant that the school shall help each pupil to enter upon his advanced or special training with the best economy of time, and with a clear conception of his fitting occupation. It should be borne in mind that a manual training school is not a trade school. The name, unfortunately, is misleading.

In the school there are five departments—literature, mathematics, science, drawing, and manual training. The name of one department has been made to cover all, and this misnomer is responsible for much of the current misapprehension concerning the work and purpose of the school. (In some American cities these institutions are known as Mechanic Arts High Schools, Industrial and Technical High Schools.) It is, however, a name so firmly rooted in the school nomenclature of the United States, that, it would, perhaps, be unwise to attempt to eradicate it. It only remains to give the name a broader meaning, and to associate with it in the public mind the full scheme of high school culture of which it forms a part.

It is not the purpose of this school, therefore, to produce mechanics, any more than it is to produce any other class of specialists. What it aims to do is to surround boys with the realities of life in both thoughts and things, and to fit them more closely to their environment. It is a system of education which is perfectly general in character, and which is recommended with the same confidence to the future student of the humanities as to the prospective worker in force and matter.

The remarks of the Chairman are quoted at length, because, in the Commissioner's opinion, they put the case for the manual training schools briefly, clearly, and convincingly.

Curriculum.

The curriculum covers a period of three years. The school-time of the pupil is divided almost equally between academic and manual work. One hour per day is given to drawing, two hours to shop-work, and three hours to the usual high school subjects.

There are five parallel lines of study, grouped as follows:—

First.—English Literature and Rhetoric, History, Political Economy, Civics, German, French or Spanish.

Second.—Mathematics, including Arithmetic, Algebra, Geometry, Trigonometry, Book-keeping, and Surveying.

Third.—Science, including Geology, Botany, Physiology, Mechanics, Physics, Chemistry, Steam-engineering, and Electricity.

Fourth.—Freehand, Constructive, and Architectural Drawing, Designing, and Modelling.

Fifth.—Tool instruction in joinery, pattern-making, wood-turning, wood-carving, forging, tin-smithing, soldering, brazing, ornamental ironwork, moulding and casting, visework, together with applied electricity and mechanical construction.

It appeared to the Commissioner, when visiting this fine institution, that the *third*, *fourth*, and *fifth* lines of study indicated wherein the great value of the school is to be found.

The Syllabus.

Course in Language and Literature.

English Language and Literature.

In developing the following courses it is purposed that the student shall secure—

1. A clear and connected outline knowledge of the history of literature in England and in the United States—the principal epochs, their characteristics and great names.
2. That he shall acquire a genuine appreciation of the imaginative and literary beauties of poetry and prose; that thus there shall be stimulated in him a taste for wholesome literature.
3. That this outline knowledge of (1) and this appreciation of (2) shall evolve largely from a continual analytical reading of classic English texts; that the influence of this studious reading shall be reflected in the themes and essays which, from time to time, it shall be his duty to prepare.
4. That he shall have a clear and, to some extent, a technical, knowledge of the relations, origin, and development of the English language; that, in general, he shall be able to discriminate the Latin from the Saxon verbal elements; and, finally, as the desideratum of these courses, that the potential literary culture thus acquired shall be rendered into a consciously direct and pure English style.

First Year.

Corresponding to the divisions of the academic year, the work assumes three distinct phases:—

(*a*) In the *first* period, texts are read in the class from the following American authors:—

Franklin, Irving, Cooper, Bryant, Emerson, Hawthorne, Longfellow, Whittier, Holmes, Poe, Lowell, Hale.

Vocabularies are culled from the texts, and required to be wrought out at home. Lectures on the life and writings of these authors supplement the class-work. The intent of the lectures is to suggest and direct lines of reading. Notes are prepared on these lectures, and themes and essays based upon the content of the readings are written at home and in class.

(*b*)

(*b*) In the *second* period, the relation, the origin, and the development of the English language is the woof shot through the corresponding warp of class-readings, themes, lectures, and quizzes. The student's attention is directed to the Latin and Saxon verbal elements. An elementary text-book is placed in the student's hands, and for theme-work reference is made to the larger works on the subject.

(*c*) The *third* period is devoted to the inculcation of the elementary rhetorical principles, variety of sentence structure, and the development of the paragraph. In this work the main effort is to impress upon the student the necessity of clearly blocking or limning his work, to give him some conception of form. All through the work of this year, attention is directed to English idioms and forms, tense sequences, and mood distinctions, as they are used integrally in the texts of the authors studied thus far. The effort is to avoid, as far as possible, anything like grammatical technicality.

Second Year.

The modern English poets are now read,—Morris, Clough, Browning, Tennyson, Keats, Shelley, Byron, Coleridge and Wordsworth; modern style is studied in the prosaists, Lamb, Hazlitt, Leigh Hunt, and De Quincey. The preparation of class themes, essays, and vocabularies is continued throughout the year, and during the last period the lectures cover the transition from Dryden and Pope, glancing particularly at Burns, Crabbe, and Cowper.

Third Year.

Steele, Addison, Swift, De Foe, and Bunyan are studied; the minor poems of Milton; Hamlet, King Lear, Merchant of Venice, Julius Cæsar, and As You Like It, are analysed. The lectures are confined to the Elizabethan literature, particularly to the seed and flowering of the drama. The preparation and delivery of orations upon themes political, economic, and historical, and the writing of graduation themes are also required in this year.

Pupils have the option of either French or German. These languages are taken up in the first year and continued throughout the entire course. In the third year pupils have the option of taking Spanish instead of French.

Courses in History, Civil Government and Economics.

An outline of essentials is afforded by the text-books used; but the main purpose held in view is to make students realise that the events of the past have a vital connection with the events of the present. The unity of history is forcibly impressed on the minds of students; and that is not a matter of detached facts, parts, sections or chapters. The proof of this continuity in the development of religious, social, and political institutions, of literature, of art, and of science, is shown by constant reference to present conditions.

In the requirements of the class-room, a clear understanding of the significance of events is kept in view, rather than an unreasoning exercise of memory in mere recitations from the text-book, with lists of names and dates.

A large part of the work consists in discussions and occasional lectures, and illustrative matter is freely introduced from various sources in order to give a more comprehensive grasp of the subjects under consideration. To this end students are urged to supplement their required class-work by additional outside reading of books recommended as suitable for the purpose, and which are to be readily obtained in the various city libraries. Every incentive is given to this sort of voluntary effort, by requiring the frequent writing of essays on important topics, in the preparation of which such collateral reading is necessary. The changes in political geography which the world has undergone in historic times are brought to the attention of students by the daily use of a progressive series of historical maps, and each student is required to prepare a similar series from outline maps provided for the purpose. In the preparation of essays, and in the frequent written reviews, the careful use of English is regarded as an essential. Due notice of lectures in the city on historical, economic, literary, and art subjects is given, and students are encouraged to attend.

General History—Second Year.

This course comprises:—

(1) A review of the ancient civilisations of Egypt, and of Chaldæa, Assyria, and Babylonia, including the history of the Phœnicians, Hebrews, and ancient Persians. The importance of their contributions to the civilisation of the West is emphasised.

(2) The History of Greece and Rome, with particular attention to the religious, political, and social institutions of these nations, their art, literature, and philosophy, and to the enduring influence of all these upon the progress of Western civilisation.

(3) The History of the Middle Age, with particular reference to it as a period of transition from ancient to modern conditions of society, and to the service rendered by the Teutonic people in this advance.

(4) The History of Modern Europe, especially of England, Italy, France, and Germany, particular attention being paid to their political, social, and economic development from the Renaissance to the present time.

American History and Civil Government—Third Year.

In the courses on American History and Civil Government the same method is employed toward obtaining thoughtful and intelligent results. Such study of the Constitutional and Political History of the United States from its beginning to the present time, and of the actual conditions of government of the Nation, State, and City, is absolutely essential to prepare young men to assume their responsibilities as American citizens. Use is made of all available help. Standard authorities from the libraries, newspapers, occasional lectures, political and industrial maps, in addition to text-books, are the means by which the student is brought to understand the institutions of his country and the duties of citizenship.

The course of instruction in Civil Government includes a careful study of the Constitution of the United States, of the State, and of the government of the county and city. The problems of municipal government are discussed, and the duties of public officers explained.

Course

Course in Economic Science—Third Year.

The course in Economics is designed to give the student an understanding of the general principles of political economy, and, as far as possible, of the great economic and social problems of the day. The operation of economic laws is shown by the study of actual conditions at home and abroad.

Course in Mathematics.

In mathematics, two ends are constantly kept in view: First, stimulation of the inventive faculty, exercise in judgment, development of logical reasoning, and the habit of concise statements. Second, the association of the branches of pure mathematics with each other and with applied science—that the pupil may see clearly the true relations of principles and things.

As a means to the first end, the pupil is required to understand the meaning and reason of all that he does, and to be able to state mathematical operations in his own language. As a means to the second end, the formulæ of algebra, geometry, and trigonometry are applied to physics, chemistry, mechanics, engineering, and surveying. In designing, and in architecture, in the calculation of surfaces and volumes in the shop exercises, and the amount of material necessary to make these exercises, the application of geometry is particularly valuable.

First Year.

Arithmetic.—General Review.

Algebra.—Introduction; fundamental operations; composition and factoring; fractions; simple equations; involution; evolution; factoring; equations of more than one unknown.

Geometry.—Introduction; straight lines; angles; triangles; quadrilaterals; polygons.

Second Year.

Algebra.—Radicals; imaginaries; quadratics; discussion of quadratic problems, with several unknowns.

Geometry.—Ratio and proportion; the circle, the ellipse; planes; solid angles; the prism, pyramid cylinder, cone, and sphere; calculation of surfaces and volumes.

Plane Trigonometry.—Logarithms; use of tables; trigonometric functions; development of formulæ; solution of right triangles; solution of oblique triangles; practical exercises.

Third Year.

Algebra.—Variations; progressions; permutations; probabilities; series; higher equations; curve tracing.

Analytical Trigonometry.—Functions of the sum or difference of two or more angles; solution of trigonometric equations; circular measure of an angle; arc functions; applications and practical exercises.

Surveying—Third Year.

The course in Surveying is intended to familiarise the student with the elementary principles of plane surveying. The time is about equally divided between the classroom and field work—the latter being done in the Park. From the notes obtained in the field, results are calculated, and various drawings and topographical maps are made.

Surveying.—Adjustment and care of transits and surveying rods; profile levelling; areas of fields; topographical levelling; topographical surveying; railroad curves.

Course in Science.

The course in Science covers three years. It has for its purpose the direct teaching of useful facts and information, and still more the culture and intellectual discipline which come from such a knowledge. The courses are therefore kept as general as possible, in the hope that they may have a large disciplinary value, and at the same time lay broad and secure foundations for future scientific study and work.

The Science work of the first year includes Geology and Botany.

Geology—First Year.

The word is understood as meaning earth-knowledge, in its widest sense. This study, dealing as it does with the physical phenomena of the earth, serves as an admirable introduction to the study of physical science the second year, and best bridges over the gap between the elementary science of the lower school and the more exhaustive study of the subject in a high school.

It is treated in a way which compels a student to make an intelligent use of text-books and works of reference, by providing him with printed syllabi containing questions on leading topics, and requiring him to sift out from a mass of more or less related matter, those points bearing upon the topic under discussion. In this way it is believed that this system of study does away with the "cramming" from a printed page.

Botany—First Year.

In taking up this work, the *laboratory* method is followed exclusively.

The work consists of a series of observations and experiments performed solely by the student, and the result—with drawings—carefully recorded in a special note-book. While reference is freely made to a number of standard works on this subject, this note-book is practically the student's text-book.

Structural botany is the main topic throughout,—although a portion of the time during the spring and summer is given to systematic botany, each pupil being required to collect an herbarium consisting of a number of local wild flowers (Phanerogams).

Physics.

Mechanics, Heat, Light, and Sound—Second Year.

The work in science during the second year is devoted to Physics. Since Mechanics is necessarily the introduction to Physics, this study forms the work of the first term. The C. G. S. system of units is used.

The study of Heat is begun after the law of the conservation of energy has been introduced to the mind of the student by the study of Mechanics. The work in Heat occupies the second term.

During

During the third term Light and Sound are studied in the classroom. In addition to this, the work of the term includes laboratory exercises, which are devoted to measurements of the fundamental physical quantities. These exercises include measurement of length by dividers and scale, by micrometer, by vernier bar caliper, measurement of area by planimeter, determination of mass by balance. Particular attention is given to the work with the balance.

The Steam Engine—Third Year.

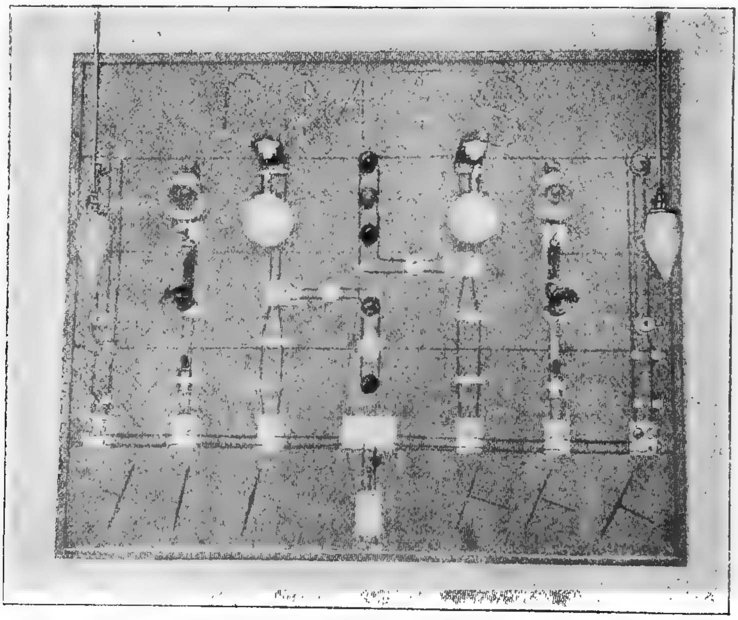
The Steam Engine is considered primarily as a means of transforming heat energy into mechanical work. The introduction of this course is consequently the study of the elements of thermo-dynamics. After this theoretical introduction the construction and the action of the essential parts of the steam engine is carefully worked out. In connection with this work, students are detailed each day to tend the engine and boiler.

Electricity—Third Year.

This course offers unusual facilities for instruction, both from a theoretical and a practical standpoint. The constantly increasing number of applications of electricity is ever opening up new fields of investigation, and is the object of this department to keep its students fully abreast of the best modern thought on the subject.

In addition to the careful study of the system of electrical and magnetic units, the practical application and measurement of electrical energy is carefully worked out in the laboratory.

Applied Electricity (Laboratory Work).—Use of ammeters, voltmeters, wattmeters, and other instruments; arranging and wiring different sorts of electric light circuits; tests of arc and incandescent lamps, wiring of circuits for electric gas lighters, bells and annunciators; tests of small dynamos and motors; testing circuits with magnets; switchboard work. Each student is required to write a full report of each exercise, containing the data, results and drawings of the apparatus, and is also encouraged to design and construct some piece of electrical apparatus, such as small dynamo or motor, switchboard, annunciator, spark coils, rheostat, telegraph apparatus, &c.



APPLIED ELECTRICITY—THIRD YEAR.
Class Exercises.

Chemistry—Third Year.

A systematic training in Chemistry has two objects:—

1. From the practical point of view, its connection with the every-day activities of life is most intimate. A broad knowledge of the subject is essential to the comprehension of many of our most important industrial processes.
2. Regarded as a means of mental development, the place of Chemistry among the sciences has, within the last decade, been completely changed. From a more or less complete collection of descriptive matter about the elements and their compounds, it is advancing with marvellous rapidity to the state of a quantitative science, with methods of work peculiarly its own, and peculiarly adapted to cultivate the power of independent thought. Many of the modern results are, of course, inaccessible to beginners, but even where a generalisation cannot be directly presented, its effect is felt in an elevation of the point of view from which the subject-matter of the science is regarded.

The instruction is by means of lectures, laboratory work, recitations and the working of chemical problems. Since the time of Rouelle the necessity of the experimental lecture in chemical instruction has been admitted by all whose opinion is of any importance. Our experience has shown that in the secondary school, as elsewhere, it richly repays the labour expended upon it, and this feature of the work is certainly permanent.

In the laboratory the student makes a rather extensive series of experiments in Inorganic Chemistry, and keeps a note-book, in which he sets down his conclusions at the time the work is done. In this way the tendency to alter results to make them conform to preconceived opinions, is checked, and there is brought about that intimate personal contact with the facts of science, which is the only source of true and lasting knowledge.

The

The work in Chemical Arithmetic is as complete as it can be made. It is found to furnish a most efficient means of enforcing the real meaning of chemical formulæ; a fundamental point, which often fails to receive the proper amount of attention.

In accordance with modern opinion, the stochiometric laws are presented purely as experimental results, the formula is considered as a wonderfully concise summary of our knowledge of a compound, and the atomic theory is introduced rather late in the course, and is regarded chiefly as furnishing an indispensable point of view from which to discuss the problems of constitution and the phenomena of isomerism.

Course in Drawing.

The importance of Drawing in its application to manual training, cannot be overestimated. It is, in fact, the first step in manual training. Without drawing the use of tools becomes a mere mechanical imitation, and has little value as an educational factor. From the conception of the idea to its expression in the concrete material, the drawing is the description by which the mechanical processes are logically developed, and brought to a definite and practical form.

From the beginning, therefore, the pupil is taught to make and interpret working drawings, and to reproduce from them the indicated forms. He must understand this "universal language" in which they are described, and acquire by education and experience the ability to use it.

Parallel with this work, the pupil's powers of observation and expression, and his artistic sense, are cultivated by the study and representation of the appearance of objects, and by designing on paper, and in clay and wood, for their ornamentation.

All work in drawing is done after verbal instruction with blackboard illustration, no text-book nor copies being used.

A close and constant relation between the draughting departments and the shops is rigidly maintained. Every mechanical or artistic product is carefully studied on a paper in all its principles and details—first through general sketches and designs, and later in working drawings—before the pupil touches the concrete thing. Thus, while in making the object, manual dexterity is acquired, the pupil at the same time learns to approach his task with a clear and accurate idea of the thing to be accomplished.

While drawing underlies all industrial work, its application is not limited to material processes. Throughout all the departments, drawing is the common language used in explaining facts, ideas, and principles. By making historical, botanical, and topographical maps, geological sketches, physical and mechanical diagrams, the pupil expresses graphically the lessons taught in the class-room.

The Course in Drawing has three general divisions:—

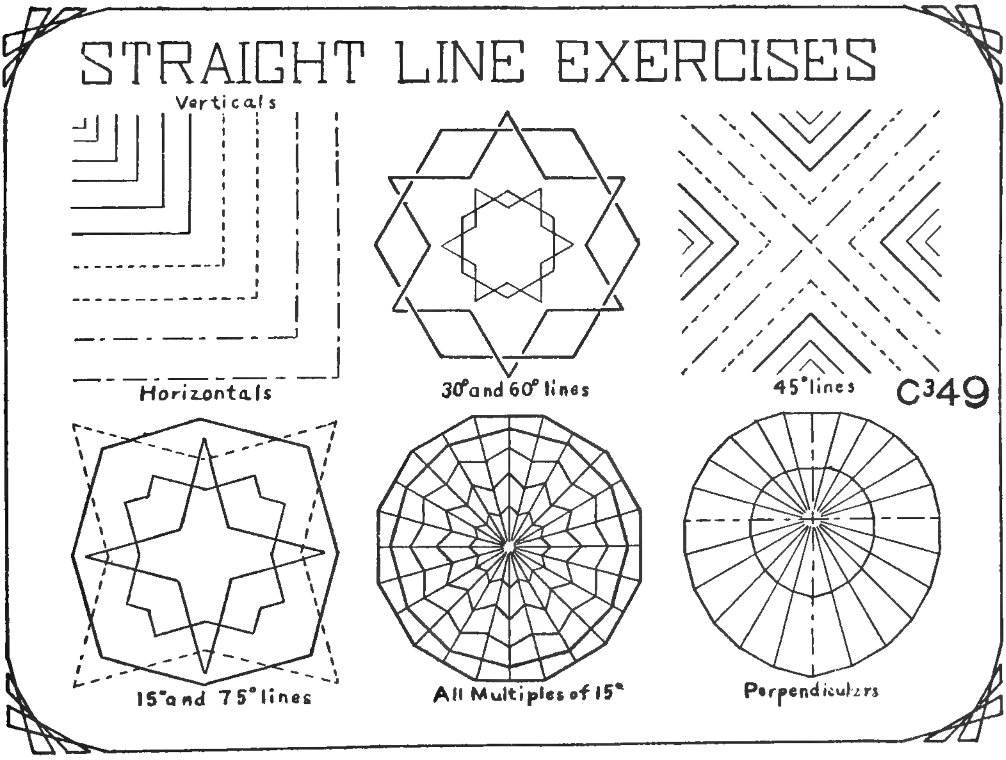
First—Constructive drawing, as the basis of all industrial pursuits.

Second—Pictorial drawing, designed to educate the sense of form and proportion, to train the eye to observe accurately and the hand to delineate rapidly the appearance of objects.

Third—Decorative drawing, used as a means of cultivating the taste, and developing an appreciation and love of the beautiful.

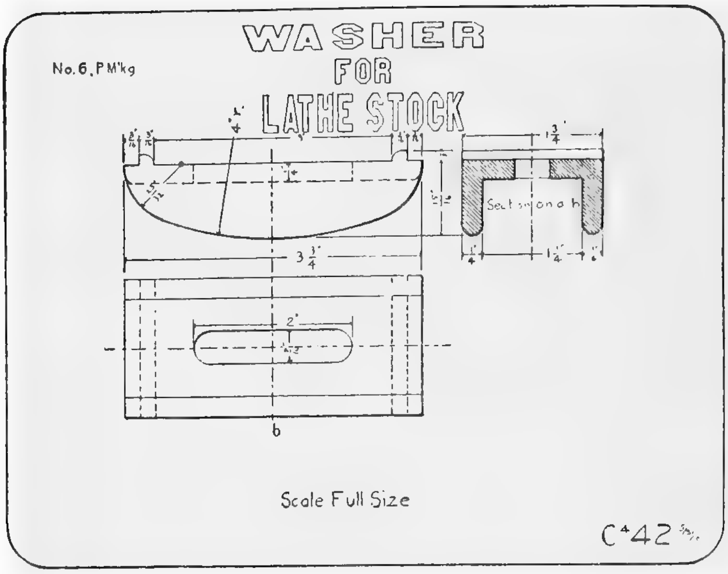
First Year.

Constructive Drawing (Freehand and Mechanical)—Proper care and use of instruments, with exercises for accuracy and neatness of execution. Preparation of freehand dimension sketches—and from them finished working drawings to scale—of the exercises which are afterwards made in the manual departments. Surface developments of simple solids. Methods and technicalities in accordance with modern practice of the best draughting rooms.



CONSTRUCTIVE DRAWING—First Year.

Class Exercise—Reduced.



CONSTRUCTIVE DRAWING—First Year.
Class Exercise (Reduced).

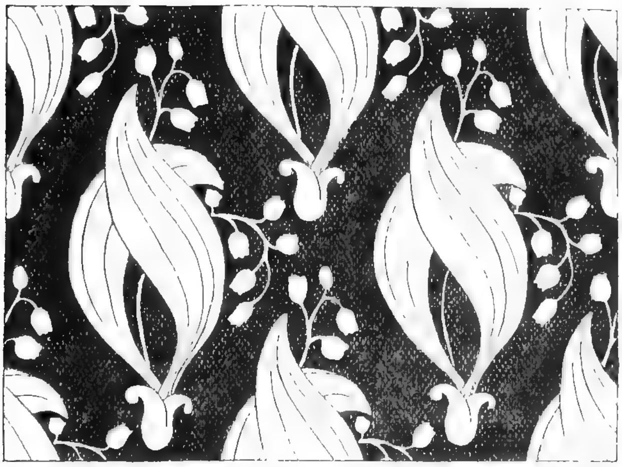
Pictorial Drawing.—Outline and shaded drawings from single objects and groups—in pencil, ink, or wash.

PICTORIAL DRAWING—First Year.
Class Exercise (Reduced).

Decorative

Decorative Drawing.—Ele mentary geometric design and historic ornament executed with the pencil and brush. Plant analysis.

HISTORIC ORNAMENT—FIRST YEAR.
Class Exercise (Reduced).

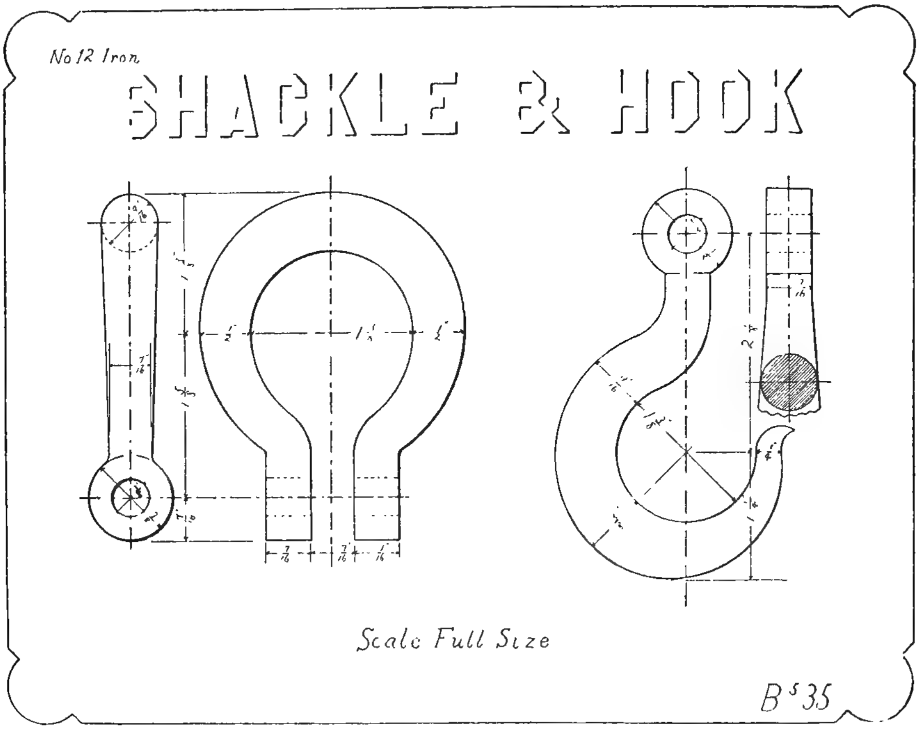


DECORATIVE DRAWING—PLANT ANALYSIS—FIRST YEAR.
Class Exercise (Reduced).

Second

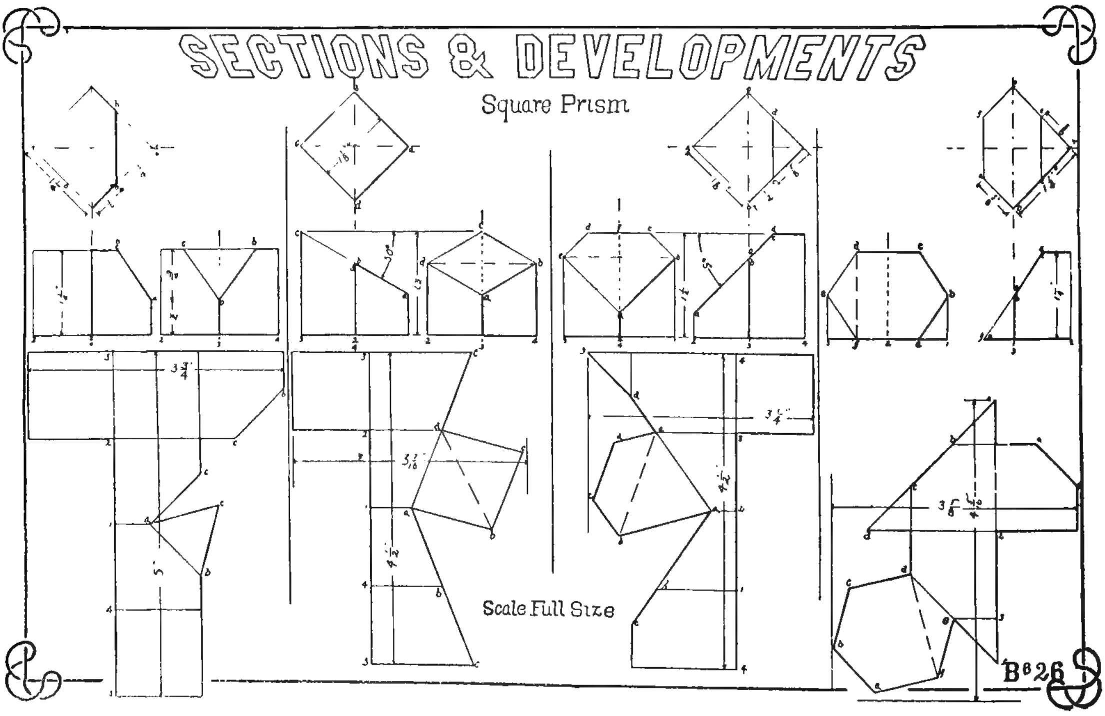
Second Year.

Constructive Drawing.—Preparation of finished working drawings (from the student's freehand dimension sketches, from blackboard drawings, and from dictated directions), to be afterwards used in pattern-making and wrought-iron work. Sections and intersections of solids with surface developments, applied in preparing working drawings for sheet-metal work. Shop tools and machine details—such as chisels, tongs, pipe fittings, pulleys, parts of lathe, steam engine, etc.



CONSTRUCTIVE DRAWING—SECOND YEAR.

Class Exercise in Forging (Reduced).



CONSTRUCTIVE DRAWING—SECOND YEAR.

Class Exercise—Reduced.

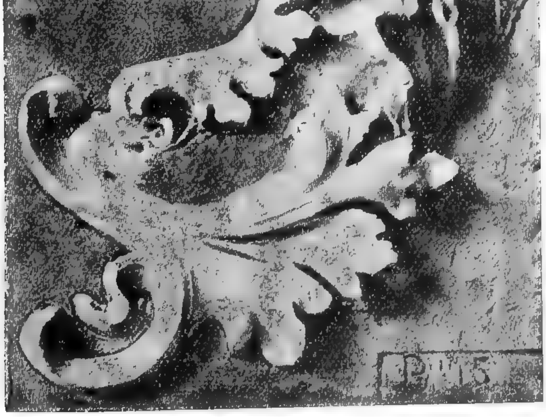
Decorative

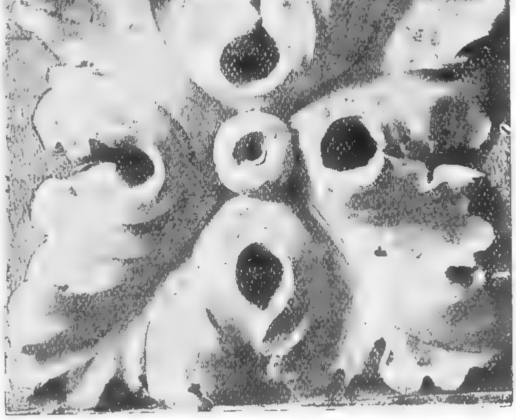
Decorative Drawing.—Designing in black and white; Conventional Design; Historic Ornament. Designs for wood-carving and wrought-iron, which are executed in the shops. Colour designs for oilcloths, tiles, and wall papers.

HISTORIC ORNAMENT—SECOND YEAR.
Class Exercise (Reduced).

Clay Modelling accompanies the more advanced work in drawing from casts, natural forms, and designing. In modelling in clay, as well as in the carving in wood, it is the aim to give a better conception of form and proportion than is attainable on the flat surface.

Modelling from designs, drawings, photographs, carvings, casts, and nature.



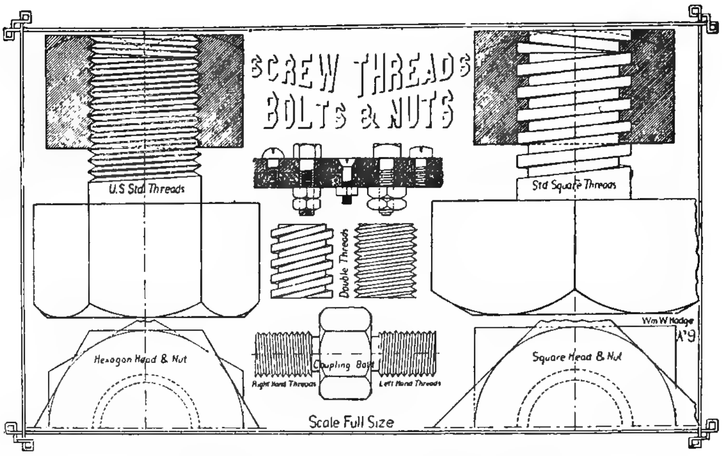


CLAY MODELLING—SECOND YEAR.
Class Exercise (Reduced).

Third

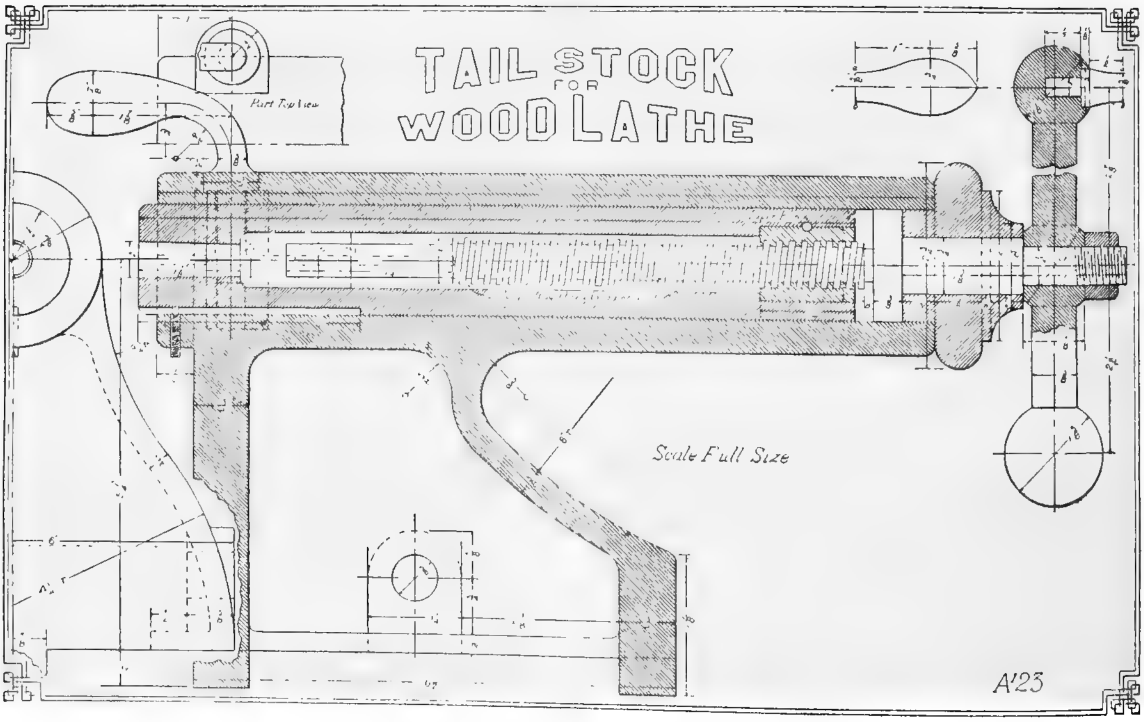
Third Year.

Constructive Drawing.—Drawings of complete machines to be used in the "projects" in mechanical construction. Designing of screw threads, gear wheels, and parts of machinery from specifications. Plotting of motion diagrams and designing cams to produce specified movements in machinery. Tracing and blue printing.



CONSTRUCTIVE DRAWING—THIRD YEAR.

Class Exercise (Reduced).

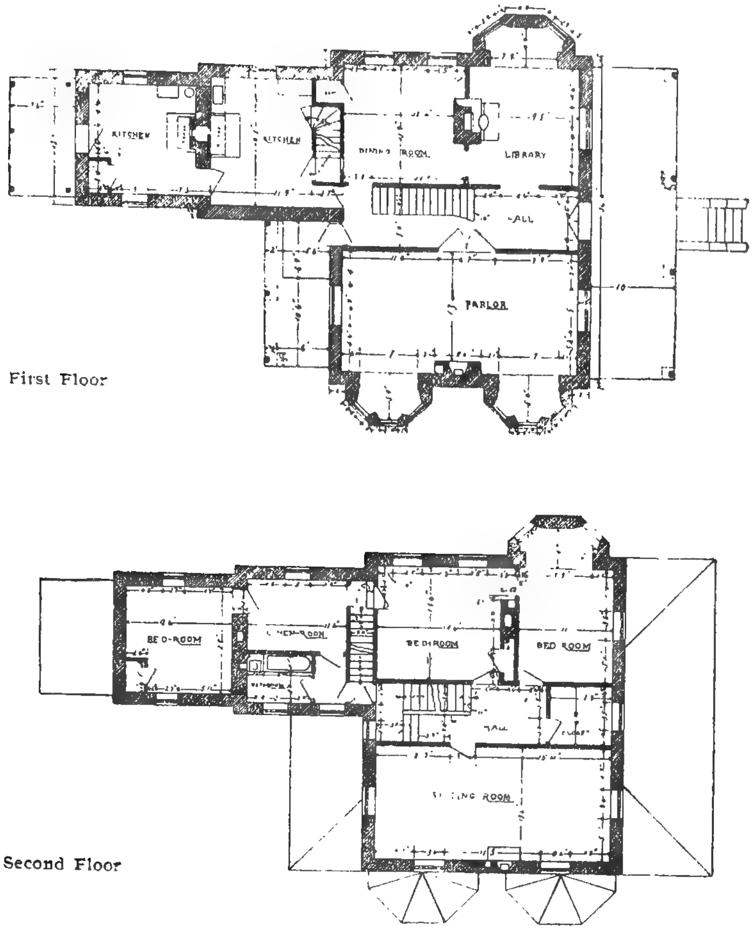


CONSTRUCTIVE DRAWING—THIRD YEAR.

Class Project (Reduced).

Architectural

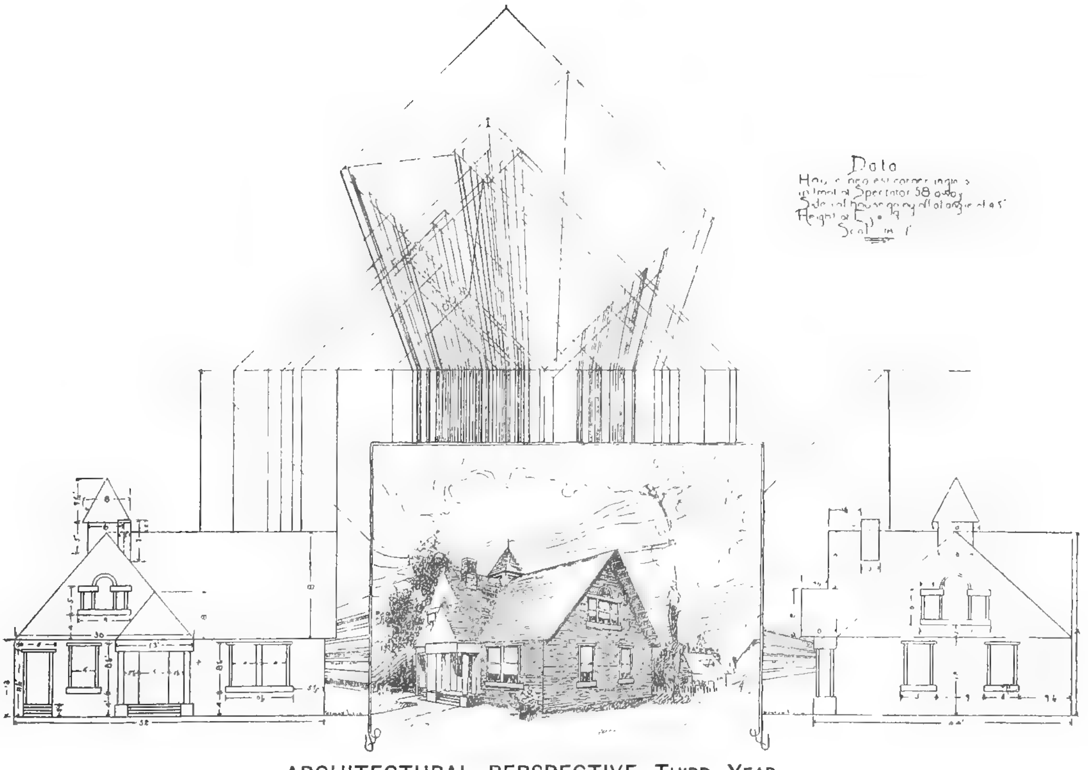
Architectural Drawing.—Ground plans, floor plans, elevations, and sections of the pupils' own houses, drawn to scale from actual measurements. Shades and shadows. Mechanical and pictorial perspective; architectural perspective developed from plans and elevations. Lectures on history of architecture.



ARCHITECTURAL DRAWING—THIRD YEAR.

Reduced Size.

(Pupil's own home, drawn to scale from actual measurement).



ARCHITECTURAL PERSPECTIVE—THIRD YEAR.

Course in Manual Training.

In this department—which is a distinctive feature of the school—each exercise involves a mechanical principle, and the chief object of the instruction is the development of this principle, rather than the production of a finished piece of work. The exercise has value only as it has rendered educational service during its construction. In the changing conditions of the thing in hand during its construction, there is a constant necessity for creating new means to meet new requirements, and the directive skill and logical processes thus evolved make manual training rise to the level of scientific or mathematical studies as a means of intellectual development.

Other values of a specific nature—accuracy of measurement, precision of adjustment, delicacy of manipulation, exactness in every particular—must be taken into account in estimating the educational value of manual work.

The shop instruction is simply a part of the laboratory methods of education. The term "shop" in this connection is as much of a misnomer as is the term "manual training," when it is applied to the whole school. It would seem more fitting, therefore, in speaking of this department, to call it a laboratory—a term which carries with it the educational significance of its work.

All the articles made in the shops are required to be of precise forms and dimensions given in a drawing made by the pupil himself previous to taking up the exercise The aim is to teach the pupil to express his thought in a concrete form with the least waste of material, in the most workmanlike manner, and in accordance with the most approved methods.

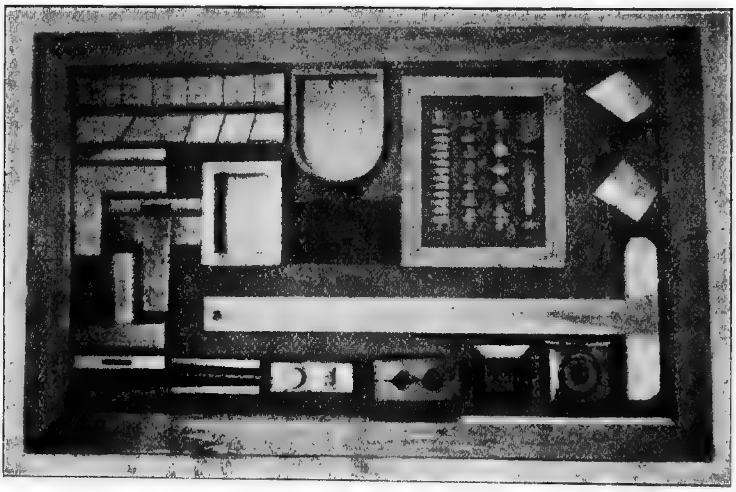
A feature of the work in the manual training departments is a weekly lecture bearing either upon the principles involved in the work of the week or the nature of the material used in construction.

Wood-work—First Year.

In beginning the instruction in this (or in any other) manual department, the simplest forms and appliances are first taken up.

As the plane is practically the first tool that the pupil takes in hand, the teacher explains its use and construction, and shows, in the presence of the class, its practical application. In like manner is explained the use of all other tools.

Emphasis is laid upon the reason for doing the work in the particular way which is the result of practical constructive experience. Thus the pupil not only obtains a conception of skill as such, but also the idea that correct results are only obtained by the skilful application of a plan clearly thought out. The endeavour is to find the best plan, and the reason for its preference.



COURSE IN WOOD-WORK—FIRST YEAR.

Exercises in planing, gauging, squaring, sawing and chiselling are first taken up, followed by a course in joinery and wood turning.

Joinery.—Halved corner; ledge joint; dovetail halved-across; mortise and tenon; section of a door mortised and panelled; mitre; dovetail; drawer dovetailed; bevelled mitre.

The last period of the year is given to elementary pattern-making. The principles of moulding are first explained to make clear the function of the pattern. This pattern is afterwards to be used in the moulding shop, and in keeping this end in view, the ingenuity of the pupil is constantly taxed in working out new methods in which these various forms are finally produced. Strict accuracy, calculations for the shrinkage of metal, geometrical measurements, and intelligent interpretation of drawings, are factors which continually enter into the construction of these exercises, thus making this kind of work, perhaps, more highly educational than any other form of wood-working.

Elementary Wood-Carving—First Year.

A series of simple designs are carved in low relief, the object being to acquaint and accustom the pupil to the use of carving tools, and to prepare him for more intricate carving the second year.

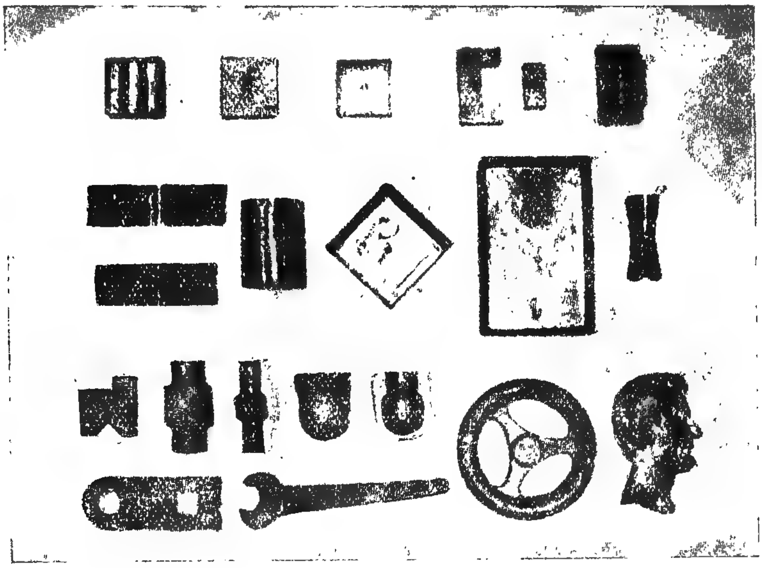
Metal-work

Metal-work—First Year.

Running parallel with the work in joinery, and alternating with the wood-working, is a course of working in cast-iron. The use and construction of the cape and flat chisel, and the different kinds of files, are first carefully explained and illustrated by the teacher. Then follow exercises in chipping, filing and fitting of plane surfaces, in which accuracy both of form and dimensions is the especial aim of the student. This work occupies the first period.

Moulding and casting forms the work of the second period. This work includes the consideration of the principles of moulding, and the making of moulds from the various patterns made in the wood shop. Lead is the metal used, not only from the facility with which it is melted, but also on economic grounds, as it can be used over and over. If time allows, the making of a cast of some ornate object is permitted.

In the third period is taken up a course in tinsmithing, including the use of the hammer, mallet, solder and soldering copper, and the properties of the various metals in sheet form are considered. The course consists in the making of various typical joints, patterns, and making complete objects, using tin plate.



COURSE IN METAL WORK—FIRST YEAR.

Upper Row—Vice Work. Middle Row—Tinsmithing. Lower Row—Moulding and Casting.

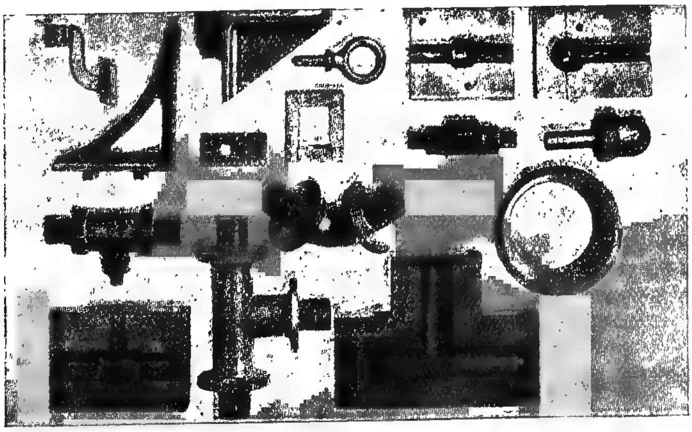
Wood-work—Second Year.

In the second year the course in wood-working is continued by a series of exercises in pattern-making.

In connection with the pattern-making the pupils take up advanced courses in wood-turning. The work of the year is closed with an advanced course of wood-carving from designs made by the pupils.

Pattern-making.—Brackets; braces; pipe-couplings; cap nut; quarter-turn; tee-pipes; hand wheels; cylindrical and conical sleeves turned from segmented rings.

Turning.—Tool handles; balusters; table legs; vases, Indian clubs, dumb-bells, etc.; face plate turning.



COURSE IN PATTERN-MAKING—SECOND YEAR.

CLASS PROJECTS—Second Year.

Metal-work—Second Year.

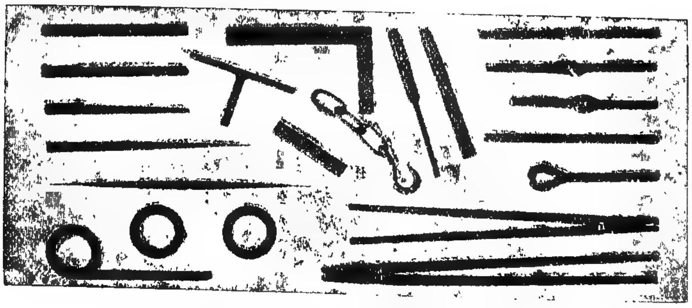
The metal-work the second year includes a course in forging, and ornamental iron-work.

Perhaps no form of manual training involves greater dexterity of hand, accuracy of eye, and quickness of thought than smith-work. From the first simple exercise in "drawing out" to the making of a pair of tongs, the necessity of striking "while the iron is hot" is impressed at once upon the mind of the pupil, and instant judgment is brought continually into play.

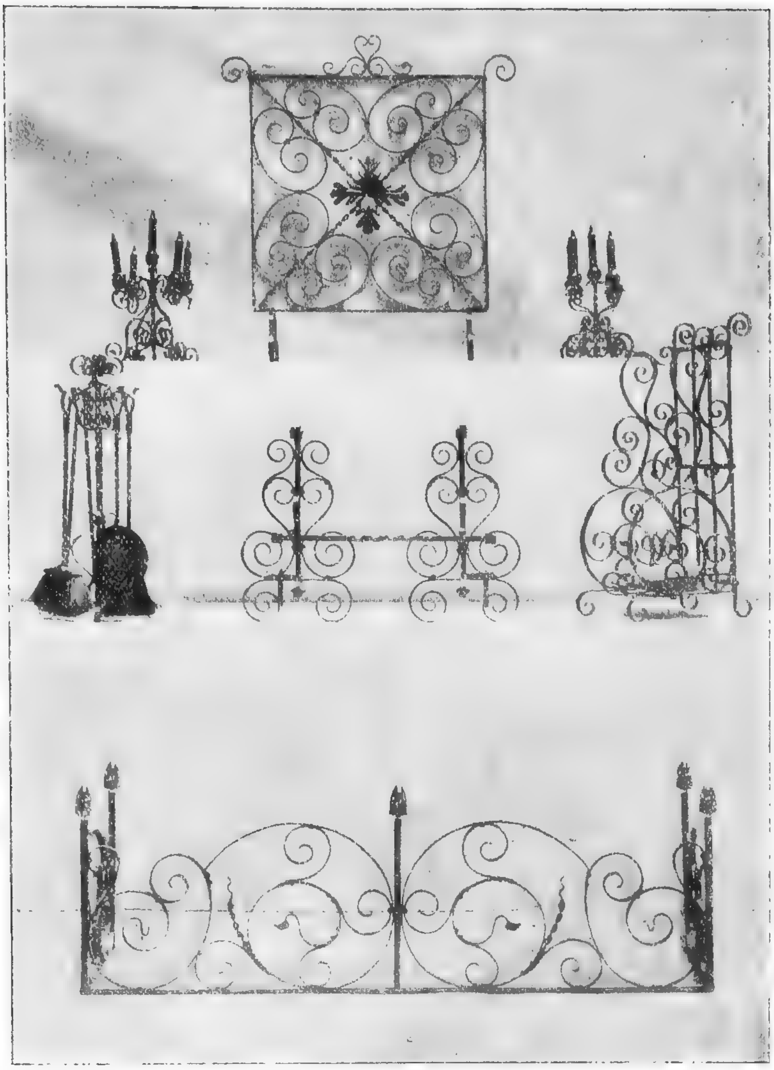
In the working of wood and cold iron, the material will wait for the pupil to exercise his judgment as to the best methods of doing the work. In the manipulation of hot iron, however, a moment's delay may result in a total failure, and the necessity of keeping the mind on the alert to meet the changing conditions of the thing in hand becomes imperative.

A course of ornamental iron-work from the pupils' own designs completes the second year's course in metal-work.

Forging.—Exercises in upsetting, drawing out, shaping, bending, welding and tempering of steel, construction of rings, chains, tongs, chisels.



COURSE IN SMITHING—Second Year.



ORNAMENTAL IRONWORK—SECOND YEAR.
Class Exercises.

ORNAMENTAL IRONWORK—SECOND YEAR.
Class Exercise.

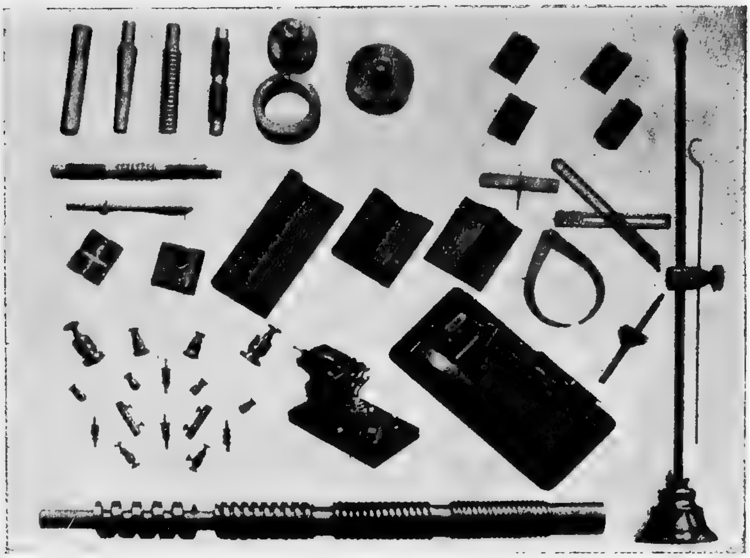
Mechanical Construction—Third Year.

In the use of hand tools, the attention of the pupil was directed to a single operation, and the end largely in view was the training of the hand. In the use of machine tools, however, where muscular power is eliminated from the exercise, the entire energy of the pupil is devoted to the guiding and controlling of the course of operation, and the judgment and directive powers are brought into play.

The object of these "power" tools is not only to give the pupils of the senior class an insight into the principles governing the action of machines, but also to supplement their previous two years' training in "hand" tools, by the construction of physical or electrical apparatus, or of some piece of mechanical construction, such as a lathe, steam engine, dynamo, motor, &c.

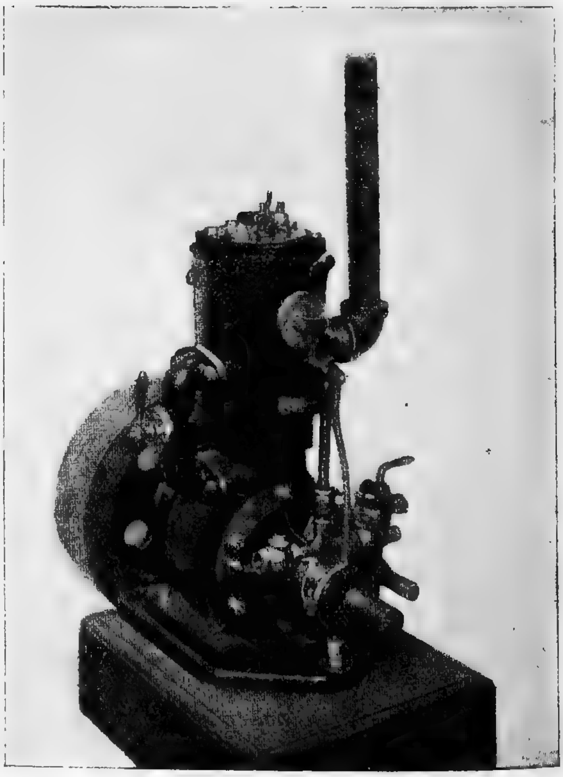
Metal-work—Third Year.

Materials.—Wrought and cast iron, Bessemer and cast steel, brass and copper. An advanced course in chipping, turning (hand, taper and screw cutting), boring and fitting, drilling and tapping, shaping, planing, use of measuring tools (micrometer, calipers).



COURSE IN MACHINE TOOL CONSTRUCTION—THIRD YEAR.

VERTICAL ENGINE—PROJECT. THIRD YEAR.



GAS ENGINE—PROJECT. THIRD YEAR.

Equipments

Equipments of the Manual Departments.

Wood-work—First Year.

Twenty-five cabinet-maker's benches, with set of tools for each bench; twenty-four wood lathes; one grindstone; one glue pot.

Wood-work—Second Year.

Twenty-four cabinet-maker's benches, each with its full set of tools; six wood lathes; one grindstone; one glue pot.

Metal-work—First Year.

Twenty-five vises, with sets of tools for each vise; one grindstone; one surface plate; six troughs for moulding: furnaces, trowels, sieves, flasks, etc., for foundry work; soldering-irons, heaters, stakes, etc., for tinsmithing.

Metal-work—Second Year.

Twenty-four forges, twenty-four anvils, each supplied with a set of tools; two light drill presses.

Mechanical Construction—Third Year.

Seven engine lathes; two hand lathes; one planer; one shaper: one drill press; six vises; one brazing apparatus; one emery-grinding machine; three large surface plates; fourteen small surface plates; one grindstone; one punch; one shearing machine; one screw press (the last three made by the pupils).

Power is furnished by a sixty horse-power Corliss engine, with a seventy horse-power boiler; one Thomson-Houston dynamo, thirteen kilowatts, and one multipolar dynamo, seventeen kilowatts.

Staff of the School.

The staff of the School, in addition to the Principal, consists of two Professors of Mathematics; a Professor of Constructive Drawing; a Professor of Physics; a Professor of History, Civics, Economics; a Professor of Freehand, Architectural Drawing, Designing; a Professor of Chemistry; a Professor of English Language and Literature; a Professor of Natural Science; an Instructor in German; an Instructor in French and Spanish; an Instructor in Mathematics; an Instructor in Joinery, Turning, Pattern-making; an Instructor in Smithing, Ornamental Ironwork; an Instructor in Pattern-making, Turning, Wood-carving; an Instructor in Constructive Work (Machine-tools); an Instructor in Vise-work, Tinsmithing, Moulding; an Assistant in Laboratories; a Janitor, who is also an engineer.

Rules of Admission.

Pupils who have completed the Eighth Grade of a Grammar School, and who, in the judgment of the Principal, are qualified for promotion, are eligible for examination to the Manual Training Schools.

The examination is under the direction of the School Superintendent, and includes reading, spelling, language, writing, arithmetic, geography, history and civil government (United States), science lessons, drawing. A minimum average of 50 per cent. is required in reading, language, and arithmetic; and a general average of 70 per cent. in all the branches.

Pupils from private schools located within the city limits, who are *bona fide* residents of Philadelphia, and who are of the required age, and of equal grade with the Grammar Schools, are permitted to attend the examinations for promotion to the Manual Training Schools, upon a certificate signed by the Principals of their school.

Classification of Pupils.

The school is divided into three classes—senior, intermediate, freshman—the work of each class covering a year. Each class is further divided into sections of from twenty to twenty-five pupils each. In the shops and laboratories, where individual instruction is necessary, single sections are handled, but in the class-rooms and drawing-rooms double sections are taught.

Government and Discipline.

The moral training of the boys of this school is considered as important as their intellectual and physical development. A persistent effort is made to enlist the power of habit in favour of what is right and truthful, and it is just here, the management of the school say, that manual training is a valuable factor in shaping these qualities. Any kind of work that demands exactness in every particular teaches truth, and the boy is unconsciously led to the love of truth by his very work. The qualities of patience, perseverance, concentration of effort, judgment, accuracy, involved in the "making of things," cannot but exert a powerful influence on what Matthew Arnold considers three-fourths of life—namely, conduct.

Requirements of the School.

The daily record of the pupils, combined with the results of written reviews held during the terms, or at their close, determines the advancement of the pupils. Reports of the conduct, punctuality, and proficiency of the pupils are sent to the parents at the end of each term. The first consideration of the pupil is the work of the school. The spirit of the school is that of earnest and faithful work. By avoiding cramming, class-ranks, and "markings," the school stimulates the student to do his best without appealing to his selfish interests. Pupils whose influence is found to be injurious are dismissed from the school, and those who fail to make good progress in their work after reasonable trial are required to withdraw. Pupils are required to furnish their own drawing instruments and aprons, the expense of which averages about five dollars to each pupil. The drawing instruments are of a uniform kind, prescribed by the Committee of the School. Books, paper, shop tools, and all other materials are furnished by the School. The hours of instruction are from 9 a.m. to 2 p.m., with a break of twenty minutes at 12·10.

Diplomas.

Diplomas, which admit to the University of Pennsylvania and other institutions of like standing without further examination, are granted to those pupils who have successfully finished their three years' course. Scholarships, tenable at the University of Pennsylvania, the Academy of Fine Arts, the School of Industrial Art, and the Lehigh University, are awarded annually to students of the highest standing in the School. These prizes make it possible for those exceptionally qualified students—the stuff out of which scholars are made—to get free the best education that the country can afford, and it is a paying investment in the return of a splendidly equipped class of young men whose value to the community is thus increased a hundredfold.

Graduates.

The claims put forward by the School as to its practical value in gaining a livelihood are fully substantiated. An examination of one thousand of its graduates reveals the fact that about 80 per cent. are engaged in pursuits demanding a high order of intelligence as well as manual skill, *e.g.*, superintendents, managers, foremen. That the school fosters a desire for higher education is shown in the fact that every year about 20 to 25 per cent. of the graduates become students in colleges, universities, or technical schools. The enrolment is about 500.

Curriculum, Central Manual Training High School, Philadelphia.

Class.	Term.	Literature, History, Etc.	Hours per Week.	Mathematics.	Hours per Week.	Science.	Hours per Week.	Drawing.	Hours per Week.	Manual Training.	Hours per Week.
Freshman (C) First Year.	1 Fall.	Literature .... German or French	3 [illegible]	Algebra	5	Natural Science .. (Geology)	5	Constructive .... Freehand	3 2	Joinery and Turning .... Vise-Work (Chip. and Fil.).... Forging .... Wood Carving (Elementary)..	4 4 1 1
	2 Winter.	Literature and .... History of English, German or French	3 2	Algebra	5	Natural Science .. (Botany)	5	Constructive .. . Freehand	3 2	Joinery and Turning .... Moulding and Casting........ Forging .... Wood Carving	4 4 1 1
	3 Spring.	Literature and Rhetoric German or French..	3 2	Algebra ...... Geometry	2 3	Natural Science .. (Botany)	5	Constructive .... Design	3 2	Pattern-making and Turning.. Tinsmithing .... Forging .... Wood Carving	4 4 1 1
Intermediate (B) Second Year.	1 Fall.	Ancient History ... German or French..	4 2	Geometry	4	Physics (Mechanics)	5	Constructive .... Design	3 2	Pattern-making and Turning.. Smithing	5 5
	2 Winter.	Mediæval History.. German or French..	3 2	Geometry ... Algebra	2 3	Physics (Heat, Light, and Sound)	5	Colour Design .. Clay Modelling ..	3 2	Pattern-making and Turning.. Smithing	5 5
	3 Spring.	Modern European History. Literature .... German or French..	3 1 2	Algebra ...... Trigonometry..	2 3	Chemistry	5	Constructive	4	Wood Carving (Advanced).... Ornamental Ironwork	5 5
nior A) Third Year.	1 Fall.	U. S. History .. ... Literature, Essays . German or French*	3 2 2	Trigonometry.. Surveying ..	3 3	Chemistry .... Physics (Steam Engineering)	5 2	Architectural .. (History of Architecture)	5	Constructive Work .... (Machine-tool Practice)	5
	2 Winter.	Civics .... Literature, Essays . German or French*	3 2 3	Trigonometry . Algebra	3 3	Chemistry	5	Constructive	5	Constructive Work .... (Machine-tool Practice)	6
	3 Spring.	Economics .... Literature, Essays.. German or French *	3 2 2	Bookkeeping .	3	Physics (Electricity) Physiology	6 1	Constructive .... Perspective......	2 3	Constructive Work .... (Machine-tool Practice) Applied Electricity	5 3

* In the third year pupils have the option of taking Spanish instead of French.

CHAPTER XXII.

CHAPTER XXII.

Manual Training Schools of San Francisco.

[J. W. TURNER.]

Introduction.—For a city of its size, San Francisco is remarkably well off in the matter of Technical High Schools. The city supports one as an integral part of its Public School System, and two others—the James Lick and the Wilmerding—are privately endowed institutions. The following description is from the Catalogue of 1902-3:—

The Polytechnic High School, San Francisco.

History.

Up to the year 1900 this school existed as a commercial and technical high school combined. In that year it was reorganised on a strictly manual training basis, and provision for the commercial classes and some of the academic studies was made elsewhere.

Aims of the School.

In its recent Catalogue, the aim of the Board of Education in establishing this course is stated as follows:—

(*a*) To correlate its work with that of the manual training of the Grammar School.
(*b*) To emphasise the educational value of manual training, as well as its great practical value to those who are to follow mechanical pursuits.
(*c*) To offer the best possible preparation for pupils intending to enter the University of California or Stanford in the Colleges of Electrical, Civil, Mining or Mechanical Engineering, Colleges of Chemistry, Agriculture, Commerce, or of Natural Sciences.

No attempt is made to develop a specialist or to teach a trade; yet in the fourteen exercises a week for three years devoted to shop practice and drawing, it is manifest, so the report of the Superintendent states, that the pupil will have acquired a manual skill and constructive ability which will enable him to master the requirements of any trade. The school is conducted on the co-educational principle along academic lines, but in the Manual Training Studies a separation takes place—boys devoting their time to shop practice and drawing, girls to various exercises in clay-modelling, wood-carving, and designing.

Expense.

Pupils are required to furnish their own text books, but drawing instruments and all tools used in the various shops, as well as all materials used in class exercises in Manual Training, are supplied by the school.

Admission to the State University.

The graduates of the Polytechnic are admitted upon recommendation of the Principal, *without examination*, to the Colleges of Mining, Mechanical, Electrical, and Civil Engineering, to the College of Chemistry and Agriculture, and College of Natural Sciences of the State University at Berkeley, California.

The Course of Study.

The course of study covers a period of three years. The academic branches—English, History, Mathematics, Science, French, German, and Latin—are the same for boys and girls. The course is presented under two heads:—

(*a*) The College Preparatory Course.
(*b*) Mechanic Arts Course.

The College Preparatory Course embraces all requirements for matriculation in the Colleges specified above. The Mechanic Arts Course is intended for those who are to enter upon active industrial pursuits directly from the school. While much time is given to practical work in the laboratory and the drawing class room, the academic training is very thorough.

Syllabus, Polytechnic High School, San Francisco, California.

English.

The course in English covers the entire three years. The literature studied is used as a warp, into which is woven training in oral and written expression and instruction in composition and rhetoric. The disciplinary effect of literature upon the observation and judgment is recognised, and by it the discriminating faculties are strengthened. Its broadening effect upon the mind is emphasised, and a love for the true and beautiful in it is developed. Throughout the course selections from the following authors are read and studied:—Scott, Addison, Macaulay, Goldsmith, Burns, Byron, Coleridge, Milton, Shakespeare.

History.

The History Course includes the requirements of the University of California for the Colleges of Agriculture and Chemistry, also the requirements for the Colleges of Mechanics, Mining, and Engineering, and is thorough in the subjects covered. The text book is "The American Government," Hinsdale's, Channing's, Students' U.S. History.

German.

First Year.

First Term.—Thirteen lessons in Collar's Eysenbach (Shorter Course). About fifty pages of easy reading. Memorising half a dozen short poems.

Second Term.—Completion of Collar's Eysenbach—about seventy-five pages of reading. Continuation of memorising poetry. Daily exercises in composition. In the first year the terms that are in constant use in a language class-room are made familiar to the pupils by constant iteration.

Second Year.

First Term.—Die Träumereien.

Second Term.—Die Nonna. Höher als die Kirche.

In this year it is the aim to do a good deal of reading. Grammar and Composition are studied in connection with the texts that are read. By the end of this year pupils should understand the teacher's remarks in German.

Third Year.

First Term.—Immensee. Mein Leber (Seume).

Second Term.—Minna von Barnhelm.

In the last year, one period the first term and two periods the second term per week are devoted to a review of Grammar and to Composition. German is this year regularly used as the language of the class-room. The following list of German text books is authorised by the Board of Education, San Francisco:—

Jognes-Meissner's German Grammar.
Collar and Curtis' Shorter Eysenbach German Lessons.
Brandt's German Reader.
Leander's Träumereien.
Hillern's Höher als die Kirche.
Baumbach Die Nonna.
Storm's Immensee.
Heyse's L'Arrabbiata.
Lessing's Minna von Barnhelm.
Freytag's Aus dem Staat Friedrichs des Grossen.
Stein's German Exercises.

Latin.

First Year.

First Term.—To Lesson XXX, Tuell and Fowler's First Latin Book. The usual drill in pronunciation and memorising. Practice in use of forms and elementary rules of syntax; also in double translation. Especial attention is paid to oral and written translation of English into Latin.

Second Term.—Continues the work of Term I. The First Book is finished and selections are read from Gradation.

Second Year.

First Term.—Cæsar's Commentaries, Books I, II.

Second Term.—The same, Books II, III.

In the first term, sentences founded on the text are each day translated from English into Latin.

In the second term, one period per week is set aside for Prose Composition

Third Year.

First Term.—Cæsar's Commentaries, Book IV. Sight reading from Gradation and Viri Romae. Prose composition.

Second Term.—Review of Grammar and Cæsar. Sight reading from Nepos. Prose composition.

The work in Latin aims to satisfy the revised Latin requirements of the University of California, or to furnish adequate preparation for the admission requirements of other universities.

French.

First Year.

First Term.—The first twenty lessons of Keetel's Elementary Grammar. A short story—La Mère Michel et Son Chat. About forty pages of easy reading. Memorising idiomatic sentences and vocabulary. Great care is given to pronunciation.

Second Term.—The twenty following lessons of Keetel's Grammar. About seventy-five pages of reading. Oral and written drill on verbs. Formation of sentences.

Second Year.

First Term.—Completion of Keetel's Grammar. The Composition work of Francois' Introductory French Composition. Le Voyage de M. Perrichon.

Second Term.—Review of Keetel's. Dictation. Oral work, bearing chiefly on the use of the verbs and idiomatic forms. The pupil is supposed to understand the use of French by the teacher in class-room work and discussion of familiar topics.

Third Year.

First Term.—Colomba. Composition work. Sight translation: Selections by Bruce.

Second Term.—Le Gendre de M. Poirier. Advanced Composition. Sight translation. General review of grammar and syntax. During the third year French is used as the language of the class-room

Mathematics.

Mathematics.

The Mathematical course proper begins with the elementary Algebra of the first or junior year, and extends throughout the three years. The first few weeks are devoted, however, to a short review of the Arithmetic. This review is so conducted as to effect the double purpose of giving the pupil a proper perspective view of the Arithmetic itself, and of blending the familiar concepts of this branch of Mathematics with the broader notions of the Algebra upon which he is about to enter, that the latter field may neither be entirely unfamiliar at the start, nor present too many difficulties in too rapid a succession.

Geometry is begun at the middle of the junior year, after which Algebra and Geometry are carried along concurrently to the end of the course. Trigonometry and Surveying are added in the third or senior year.

Algebra.

First Year.

Definitions and notation, fundamental operations on integral and fractional expressions, factoring, remainder and factor theorems, synthetical division, binomial theorem for integral exponents of the binomial, theory of exponents, radicals, equations of the first degree, single and simultaneous, solution of equations by factoring, practical examples and problems on equations.

Second Year.

Theory of quadratics, complex quantities, elimination with equations higher in degree than the first, the three progressions, other simple series, determinants, exponentials and logarithms.

Third Year.

Elements of the theory of equations, indeterminate coefficients with applications, partial fractions, expansion of functions, summation of series, binomial theorem for any exponent, permutations and combinations.

Geometry.

The course in Plane and Solid Geometry comprises the ordinary propositions of Plane Geometry, with an introduction to Modern Geometry, and the most important propositions of Solid Geometry with their practical applications.

It is the aim from the very beginning of the mathematical course to emphasise modern methods of thought and treatment, to teach the pupil to generalise his ideas and to broaden his conceptions, and to keep the instruction throughout the course on a rigorously logical basis. At the same time, the practical applications of the work are constantly kept in view, and utilised wherever possible for illustrative problems.

Surveying.

In this course in the senior year will be summed up and made of practical use the mathematics of the preceding years. In connection with the subject of Trigonometry, in the first semester will be given a course in the use and manipulation of surveying instruments—the chain, tape, level, transit, theodolite, etc.,—dealing specifically with their care, adjustment, proper uses, the source of possible errors and how to guard against them.

Here, also, will be discussed the different kinds of surveying—ordinary land surveying, mine and tunnel work, railroad location, topographic and traverse work—the best ways of attacking problems as they arise, and the different methods of arriving at the same results.

In the second semester this course will be continued by actual field-work with these instruments, under direct supervision of the teacher. Our parks, and the many country places so readily accessible, both by boat and train, offer exceptional opportunities for such work. Here, also, is combined a pleasant, invigorating, outdoor excursion, with actual practice in measuring distances, setting up and working with instruments, the correct interpretation of observations, and learning the most convenient forms of keeping notes and records of readings and measurements. The pupil *does* the actual work with actual instruments, and the ideals of theory become nearer a reality than in any other possible way.

This work during the second semester furnishes the necessary data for all the trigonometric applications in the solution of triangles; and what might become an abstract, uninviting book study becomes a real, live, interesting subject, because the pupil is doing the actual, practical work himself. This field-work will also be made the basis for considerable work in the drafting-room, thus broadening the scope of that course.

Such a course, combining the theoretical with the practical, both in mathematics and instrumental work, is of the highest value to any pupil, and especially to those who are looking forward to the civil, mechanical, electrical, mining, or other engineering professions.

The aim of the whole course is to make it useful, helpful, and practical, to teach the student to rely upon himself, and devise new ways of doing things as new conditions arise. It will suggest new ideas to him concerning his mathematics, train his hand in dextrous, accurate manipulation of instruments, his mind in clearness and keenness, and strengthen his judgment.

Course in Physics—Four Terms.

I. Dynamics of Fluids.—(One Term of Junior Year.)

(*a*) Laboratory Work.—Twenty-three or more experiments on Mensuration and the Dynamics of Liquids and Gases; four experiments on Simple Machines; fourteen experiments on Elementary Heat.

(*b*) Recitations and Class Demonstrations:—Properties of Matter, Density and Specific Gravity, Hydrostatics and Pneumatics. Discussion of results of laboratory work in Dynamics of Fluids, Mechanics, and Heat.

Comment upon work of all four terms:—In recitations, especial attention is given to practical illustrations.

In class demonstrations, experiments by the teacher illustrate the important laws and the portions of Physics not covered by pupil's own experiments.

In laboratory work emphasis is placed upon form-work, accuracy and neatness of note-books.

Frequent reference is made to the books of the science library.

II.

II. Sound and Light.—(One Term of Junior Year.)

(*a*) Laboratory Work.—Twelve or more experiments on wave-motion, the pendulum, sound-waves, and vibrating strings.
Nineteen or more on light, candle-power of a lamp, plane and curved mirrors, lenses, etc.

(*b*) Recitations and Class Demonstrations:—
Sound: Origin, transmission, reflection, etc. Musical scale, laws of strings, the phonograph, the ear, musical instruments, laws of the pendulum.
Light: Origin, transmission, photometry, reflection and refraction, dispersion and prismatic analysis, colour, spectra and spectroscope.
Optical Instruments: The camera, the eye, the projection lantern, the simple microscope, the compound microscope, astronomical telescope, terrestrial telescope, field-glass, etc.

Note.—One year's instruction in Chemistry precedes the following work.

III. Magnetism and Electricity.—(One Term of Senior Year.)

(*a*) Laboratory Work.—Four or more experiments in Magnetism, including drawings of magnetic fields.
Twenty-two experiments in Electricity, including study of various cells and instruments, electrical measurements, the telegraph, construction and use of the dynamo.

(*b*) Recitations and Class Demonstration:—
1. *Static Electricity*: Electrical machines, condensers, lighting, etc.
2. Magnetism.—Magnets, force-lines, and magnetic fields. Terrestrial magnetism.
3. Electricity.—The voltaic cell and electrical quantities. Effects, physiological, chemical, heating, and magnetic. Illustrations of electroplating, the electric forge, solenoids, and electro-magnets. The laws of resistance, measuring instruments, fall of potential, divided circuits, current induction, the transformer, the dynamo, the motor, arc and incandescent lighting, the telegraph, telephone and thermo-electric currents. Brief discussion of electric waves (wireless telegraphy, etc.).

(*c*) Problems throughout the term on practical questions of Junior work (Dynamics of Fluids, Sound and Light); also problems in Electricity.

IV. Heat and Mechanics.—(One Term of Senior Year.)

(*a*) Laboratory Work.—Twelve experiments on heat measurements. Eleven experiments on mechanics.
(*b*) Recitations and Class Demonstrations.—1. Heat. Thermometers, sources, expansion, melting, evaporation, boiling, distillation, and heat measurements. Conduction, convection (ventilation), artificial ice, etc.; steam and the steam-engine, hygrometry and meteorology (clouds, fog, rain, etc.); radiation (thermal effects). 2. Mechanics. Simple machines, equilibrium, parallel forces and non-parallel forces. Gravitation and centre of gravity. The laws of motion; falling bodies; work and energy. Thermo-dynamics (relation between heat and work). Curvilinear motion.
(*c*) Problems throughout term on Calorimetry and the various subjects of mechanics.

Chemistry.

First Term—
(*a*) Laboratory Work.—Experiments with some of the non-metallic elements, *e.g.*, hydrogen, oxygen, nitrogen, chlorine, bromide, iodine, and fluorine, and with some simple compounds—water, acids, bases, and salts.
(*b*) Class Demonstration and Recitation.—Explanations of difficulties in laboratory work and the development of the principles involved.
Elementary chemical theory, *e.g.*, the laws of combination in definite and multiple proportions, reactions and the atomic theory.

Second Term—
(*a*) Laboratory Work.—Further experiments with non-metallic elements, *e.g.*, carbon, sulphur, and phosphorus; and with the common metals and their compounds. Some simple organic processes—fermentation, bread and soap making.
(*b*) Class Demonstration and Recitations.—Explanations of laboratory work, and further development of the chemical theories of valency, nascent state, Avagadro's law, the periodic law, and electrolysis.
(*c*) Chemical Arithmetic.—Numerous problems, involving both weights and volumes of the products of various chemical reactions.

The instruction in Chemistry extends over one year, and occupies five periods a week; three of which are given to laboratory work, and two to class demonstrations and recitations. The constant aim of the instruction is to make the bearing of the work on the phenomena and industries of everyday life as direct as possible, taking illustration from the methods of mining, gas-making, soap-works, acid and powder works, and smelters.

Manual Training.

Shopwork is taken primarily for its disciplinary and educational value; for the intellectual stimulation resulting from physical activity along some line of work requiring constant mental effort. Incidentally, though in no sense trade teaching, it furnishes a valuable foundation for many mechanical occupations.

The instruction is aimed to follow the best shop methods as closely as can be done without sacrificing the educational feature. Carefulness and accuracy are insisted upon from the start, since otherwise exact thinking and mechanical progress are alike impossible. All exercises must agree in form and dimensions with a drawing or blue print furnished the pupil.

The course is designed to embody a definite mechanical principle in each exercise, and to introduce successively the different shop tools.

The equipment of machinery, tools, and drawing instruments for work in this department is mplete and of the best quality. Material for the exercises, tools, and drawing instruments are furnished ee by the school.

The

The course is a follows :—

First Year.

First Term.—Care and use of tools, joinery, wood-turning, forging.
Second Term.—Wood-carving, forging, cabinet-making, pattern-making.

Forging is taken once a week through the year. The exercises involve the operation of drawing, binding, upsetting, welding, tempering, etc.

During the second term the pupils are taught the use of all the common wood-working machines—as band and jig saws, circular saws and planers; in the construction of various projects, such as book-cases, cabinets, cases of drawers, etc. These are often elaborately carved, and may become the property of the student upon his paying for the material used.

In pattern-making, the students work to the drawings of shop projects made by the pupils of the middle and senior years. Castings are afterwards made from these patterns and the finished machine constructed in the machine shop.

Second and Third Years.

Metal work in the machine shop, which is well-equipped with a complete line of machine tools, including engine and speed lathes, drill presses, milling machine, planer, and shapers.

The pupil is first given a series of preliminary exercises in chipping, filing, fitting, straight and taper turning, screw-cutting, milling, gear-cutting, and planing in the planer or shaper.

After a reasonable degree of accuracy has been developed, he is put to work on some project of value for the school or himself.

Mechanical Drawing.

The course in Mechanical Drawing is designed to conform to the admission requirements of the University of California, and also to meet the needs of those pupils whose future employment is to be in the shop or drafting room. With this idea in mind, the work is made as practical in its nature and applications as possible.

First Year.—Care and use of instruments, geometric figures and constructions, lettering, orthographic projection of lines, plane and solid figures.

Second Year.—Sections and intersections of solids and development of surfaces; isometric, simple working drawings for shop, tracing and blue printing; elements of machines. (For architectural students, details of construction.)

Third Year.—Mechanical, working and general arrangement, drawings of machines in the shop from sketches and measurements, also designs for some machine, as a lathe, gas engine, emery grinder, or electric motor, to be built later in the shop.

Third Year—Architectural.—Study of orders, perspective, elevations and detail drawings of a house or other building.

Freehand Drawing and Decorative Design.

This course is planned for general students and is a part of the regular curriculum of the school. It is broad in its nature and embraces both the practical and aesthetic lines of study. Throughout the whole work of the department the aim is to encourage practical as well as artistic expression along original channels. The work is not arranged for the benefit of pupils of special talent only, but is so planned as to come entirely within the scope of the average High School student. Pupils are trained in correct perception and in expression through the mediums of pencil, charcoal, pen and ink, colour, modelling in clay, and carving in wood. The powers of expression and execution are cultivated along the lines that have direct relation to the life and interests of the pupils.

The course for girls is divided into Elementary, Intermediate, Advanced.

Elementary......
- (a) Freehand drawing from still life in outline and in light and shade.
- (b) Elementary principles of design.
- (c) Clay modelling from casts and nature.

Intermediate ...
- (a) Freehand drawing from casts and flowers.
- (b) Study of historical ornament.
- (c) Pen and ink from copy, for technique.
- (d) Still life in monochrome.
- (e) Modelling from the flat.
- (f) Elementary wood-carving.

Advanced ......
- (a) Freehand drawing from the antique and from life.
- (b) Applied design in colour for textiles.
- (c) Original designs applicable to all the industrial arts.
- (d) Historical ornament in colour.
- (e) Illustrations in pen and ink and wash.
- (f) Architectural carving.

The course for boys includes freehand drawing, lettering, wood-carving, and illustrative design.

Elementary......
- (a) Freehand drawing of geometrical solids and machine fragments.
- (b) Freehand lettering.
- (c) Elementary wood-carving.

Intermediate ...
- (a) Freehand Elementary machine drawing.
- (b) Freehand working drawings of tools and machines.
- (c) Wood-carving continued.

Advanced ......
- (a) Still life and antique in charcoal.
- (b) Decorative and illustrative work in pen-and-ink.
- (c) Finished drawings of machinery in the wood-work and machine shops.

Summary

Summary of the Polytechnic High School Course, San Francisco.

First Year.	Periods per week.
English Language, Literature, and Debate	3
Civil Government	2
Algebra	5
Physics (two double periods for laboratory work, and one single period for class demonstration each week)	5
German or French	3
Latin	3
Drawing	4
Woodwork (boys) or Industrial Art (girls). (Two double periods each day)	10

Second Year.	
English Language, Literature, and Debate	3
United States History	2
Plane Geometry, and begin Solid	5
Chemistry (two double periods for laboratory work, and one single period for class demonstration each week)	5
German or French	2
Latin	3
Drawing	4
Ironwork (boys) or Industrial Art (girls). (Two double periods each day)	10

Third Year.	
English Language, Literature, and Debate	3
United States History	2
Solid Geometry, advanced Algebra, and Plane Trigonometry and Surveying	4
Advanced Physics (two double periods for laboratory work, and one single period for class demonstration each week	5
German or French	3
Latin	4
Drawing	4
Ironwork (boys) or Industrial Art (girls). (Two double periods each day)	10

The Staff.

The Staff, in 1902–3 was constituted as follows:—Principal; Professor of English and History; Professor of Mathematics; Professor of Science; Instructor in Manual Training; Assistant in English and History; Assistant in Science Department; Assistant in Mathematical Department and Teacher of Surveying; Teacher in Machine-shop and Forging; Head Teacher of Freehand Drawing and Industrial Art; Assistant in Freehand Drawing and Industrial Art; Teacher of German and Latin; Teacher of French.

CHAPTER XXIII.

CHAPTER XXIII.

Manual Training Schools of America (Girls).

Department of Education—Courses of Study for the Girls' Technical High School, Borough of Manhattan, New York, 1903; Programme, Brookline and Providence.

[J. W. TURNER.]

The courses of study for the Girls' Technical High School, Borough of Manhattan, City of New York, 1903, are appended. The immensely practical nature of the optional subjects in the second year of the two years' course may be pointed out here. Home and Social Science, including household management, elementary chemistry and cooking, sewing, sanitation, elementary nursing, receives four periods of fifty minutes each every week during the first year of the two years' course, while in the second year of the course a pupil may choose from applied art (advanced drawing, colour, modelling, carving, design and applications); Printing (type-setting, machine and case, proof-reading); Dressmaking, with sewing machine and its applications; Millinery; Commercial Course (stenography and typewriting, bookkeeping, correspondence, office economy, or store practice and measurements); Physics; Library Economy; Manual Course (mechanical drawing, woodwork, paper-boxmaking, bookbinding, &c.). Each of these optional subjects receives five periods of fifty minutes each per week.

Two Years' Course.

First Year.

	Periods.
English ...	5
French, German, or Spanish ...	5
Home and Social Science (household management, elementary chemistry and cooking, sewing, sanitation, elementary nursing) ...	4
Stenography and Penmanship ...	3
Commercial Arithmetic ...	3
Physical Culture and Physiology ...	2
Drawing and Design ...	3
Music ...	1
	26

Second Year.

	Periods.
Required:—	
English ...	5
French, German, or Spanish ...	5
History (English and American) and Civics ...	3
Physical Culture ...	2
Music ...	1
	16
Optional:—	
Applied Art (advanced drawing, colour, modelling, carving, design, and applications) ...	5
Printing (type-setting, machine and case; proof-reading) ...	5
Dressmaking, with sewing machine and its applications ...	5
Millinery ...	5
Commercial Course (stenography and typewriting, bookkeeping, correspondence, office economy, or store practice and measurements) ...	5
Physics ...	5
Library Economy ...	5
Manual Course (mechanical, drawing, woodwork, paper-box making, book binding, etc. ...	5
	40

General Provisions.

1. A period shall not exceed fifty minutes.
2. Physiculture and music shall not be regarded as subjects requiring preparation.
3. Other activities involving the applications of art to industry may be introduced by the Committee on High and Training Schools on the recommendation of the Board of Superintendents.
4. A certificate setting forth the studies successfully pursued shall be given at the end of two years to all students who have taken the required studies and a sufficient number of optional studies, so that the total number of periods of study requiring preparation shall be not less than 1,400

Four Years' Course.

First Year.

	Periods.
Required :—	
English ...	5
Latin or German or French ...	5
Algebra ...	5
Biology (including Physiology, Botany, and Zoology, in different parts of the year ...	5
	20

Second Year.

Required :—	
English ...	3
Latin or German or French ...	5
Plane Geometry ...	4
Greek and Roman History ...	3
	15
Electives :—	
Greek ...	5
German ...	5
French ..	5
Spanish ...	5
Chemistry ...	5
	25

Third Year

Required :—	
English ...	3
Latin or German or French ...	5
English History ...	2
Physics* ...	5
Geometry and Algebra (second course)† ...	3
	18
Electives :—	
Greek ...	4
German ...	4
French ...	4
Spanish ...	4
Stenography and Typewriting...	4
Bookkeeping ...	3
Economics ...	3
Botany or Zoology ...	4
	30

Fourth Year.

Required :—	
English ...	3
A foreign language ...	4
Chemistry or Physiography‡ or Biology ...	4
English and American History and Civics ...	4
	15
Electives :—	
Physics, as in Third Year ...	5
Greek ...	4
Latin ...	4
German ...	4
French ...	4
Spanish ...	4
Mathematics ...	4
Stenography and Typewriting...	3
Economics ...	3
Domestic Science (sewing, cooking, and household economy) ...	3
Commercial Law and Commercial Geography ...	3
Additional Latin or Greek or English ...	3
Mediæval and Modern History ...	3
	47

General

* A student preparing for college, who has already taken two foreign languages, may substitute a third foreign language for science specified. At least one period a week of Physics shall be devoted to unprepared work.
† Bookkeeping may be substitued for Geometry and Algebra.
‡ A student preparing for college, who has already taken two foreign languages, may substitute a third foreign language for science specified.

General Provisions.

1. A period shall not exceed fifty minutes.

2. Drawing and art study shall be required two periods per week and vocal music one period per week throughout the first two years. Drawing and art study shall be optional one period a week throughout the third and fourth years. Those who intend to enter a training school should take this course throughout the third and fourth years.

3. The equivalent of two periods per week shall be devoted to physical training throughout the course.

4. Drawing and art study, physical training, and vocal music shall not be considered as subjects requiring preparation.

5. Of subjects requiring preparation, no student shall be required to take more than twenty-one periods per week.

6. No new class in an elective subject need be formed in the second year for less than 25 pupils; in the third year for less than 20 pupils; in the fourth year for less than 15 pupils.

7. Exercises in voice training and declamation shall be given at least once a week during the first year, and may be continued throughout the course.

8. In order to graduate from a high school a student must have studied at least one foreign language for at least three years, have accomplished satisfactorily all the other required work, and have taken a sufficient number of elective studies so that the total amount of required and elective studies shall equal 3,000 periods of work requiring preparation, and shall extend over not less than three years and not more than six years. Due credit shall be given by the Principal of a High Schools for work done by a pupil in other High Schools.

9. After July 31, 1902, a student's proficiency in each subject presented for graduation shall be determined in accordance with rules to be prescribed by the Board of Superintendents, by the examination conducted by the College Entrance Examination Board. A diploma of graduation shall be issued to each student who successfully passes this examination and who complies with the foregoing conditions. A certificate of having successfully completed the course of study for High Schools, shall be issued to each student who has complied with the foregoing conditions, but who does not take the above-mentioned examination.

Female Teachers of Wood-work.

A unique experience in manual training was gained in the schools of the United States and Canada, The employment of women teachers in the States for the ordinary school subjects is very general, but their qualifications in some cases fit them also take charge of the manual training classes in wood-work (sloyd). In the City of Boston in 1901, there were twenty special female instructors in cooking, forty in sewing, and eighteen in manual training. Educationists in the United States regard the employment of women in this capacity as one of the best features of the organisation.

In the High School, Montreal, a lady teacher takes classes of boys for practice in wood-work. The centre system, where pupils from several adjacent schools are brought to a common meeting place, has proved both effective and economical in America. We have the same plan in this State, but on too small a scale.

Grammar Schools with Practical Tendency.

A class of primary school which finds favour with the people in some American cities is that in which the pupils remain on, forming a 9th grade about the age of 15 years; but instead of Latin or French, which other 9th grade Grammar Schools include in their programme, this particular school specialises in manual training and domestic art. The William T. Lincoln School in Brookline, under a lady principal, is a good type of the school referred to. It has all the usual Grammar School equipment and in addition, a physics and chemical laboratory. Sewing and cooking are taught by special teachers, and its equipment includes a room for cooking and a well-furnished dining-room. The syllabus of work in the Brookline school on the practical side is here quoted.

BROOKLINE GRAMMAR SCHOOL.

Manual Training.

The Kindergarten, Gifts and Occupations—

Grade I. Selected Kindergarten occupations work in connection with other studies.

„ II. Paper cutting and folding. Construction work in connection with number, language, and history.

„ III. Clay modelling and cardboard work.

„ IV. Knife work with wood of two dimensions.

„ V. Advanced work with knife and simple tools.

„ VI. Mechanical Drawing. Models constructed from drawings with the use of suitable tools.

„ VII. Mechanical Drawing. Projections of geometrical solids, working drawings. Advanced Sloyd and wood-carving.

„ VIII. Mechanical Drawing work of Grade VII continued. Designs copied and original wood-turning.

„ IX. Mechanical Drawing continued. Bench work. Elementary cabinet-making.

Domestic Art.

Grade III. Use of scissors. Short seams. Basting, stitching, backstitching, running, hem felled, oversewing, overcasting, hems measured and finished. Supplementary work: Work-bag of checked linen.

„ IV. Three-inch model of French seam. Mark name by stitching. Hemmed-on patch. Stitched-in patch. Supplementary work. White muslin apron with drawing string.

„ V. Oversewed patch used on lighter cloth. Darning stockings. Making button-holes. Supplementary work: Cooking outfit for sixth year, to be cut and prepared by girls of higher grade.

„ VI. General care of house; airing, sweeping, dusting, cleaning, care of beds, table setting, washing of dishes, care of fire, stove, and lamps. Make truck measure; fold cloth for trucks; make gusset measure; cut and sew gusset in end of seam; sew gathered piece into a waist-band; button-holes and loops; sew on buttons with tape; whip and sew on ruffle; darning. Supplementary work: white cloth skirt.

„ VII. Water and its effects upon foods. Milk as a typical food. Fat in cooking. Experiments with albumen and starch. Cooking of eggs, vegetables, and cereals. Bind white cloth sampler with thirty-five different models of sewing. Supplementary work: Diagrams for undergarments drafted from measurements; study different qualities of cloth.

„ VIII. Combinations of starch and proteid. Cooking of fish and meat, meat soups and gelatine dishes. Yeast bread. Baking-powder mixtures. Study flannels of different weight and their adaptation to different uses. Materials for stockings. Ginghams and muslins. Fine darning. Use of sewing-machine. Supplementary Work: Flannel skirt finished with slight embroidery; hem-stitched undergarments; Mexican work; lace work.

„ IX. Canning of fruit and jelly making. Plain pastry, cake, simple puddings, salads, frozen dishes. Invalid cookery. Shirt waist cut and fitted and made on machine. Dress lining fitted by the "art of pinning on." Dress cut, fitted, and made. Hooks and eyes. Sewing on of braid, &c. Millinery begun. Notes taken of all lessons.

MANUAL TRAINING HIGH SCHOOL, PROVIDENCE.

Course of Study.

The small figures after the studies designate the number of exercises a week; the figures in parentheses, the number of weeks the studies are taken.

A period means forty-five minutes. All periods in manual work are double periods.

School sessions from 9 a.m. to 3 p.m., with a half-hour recess for lunch, which is served in the building.

First Year.

I. Academic Work—

Literature—Elementary Rhetoric and English Composition[4] (40). American Literature and Authors[1] (40).
Mathematics—Algebra[4] (40). Arithmetic[1] (40).
Science—Physiography[5] (20). Book-keeping alternating with Physics[5] (20).

II. Manual and Art Work—

Drawing[5] (40)—Lettering and Geometrical Figures. Working Drawings in connection with Carpentry. Geometrical Figures. Drawing from Models—Freehand. Drawing from Casts—Historic Ornament. Elementary Designs—Plant Forms.
For Boys—Carpentry and Joinery[5] (20). Smithing and Ornamental Ironwork[5] (20).
For Girls—Sewing[5] (20). Carpentry[5] (15). Emergency Notes. Physiology and First Aid to Injured[5] (5).

Second Year.

I. Academic Work—

Literature—Ancient and Mediæval History 2½ (20). English Classics and Composition 2½ (20). English History fundamental to American Institutions 2½ (20). German 2½ (20).
Mathematics—Geometry[5] (40).
Science—Physics alternating with Civil Government[5] (20). Physics[5] (20). General Chemistry—Girls' course preparatory to Cooking[5] (20).

II. Manual and Art Work—

Drawing[5] (40)—For Boys—Designs in Wrought Iron. Geometrical Figures. Orthographic Projection. Elementary Machine Drawing—Freehand. Designs for Wood Turning—Classic Forms.
For Girls—Historic Ornament for Wood-carving Designs. Values in Light and Shade. Pen and Ink rendering. Charcoal—From Casts and Objects.
For Boys—Clay Modelling and Wood-carving[5] (20). Smithing—Toolmaking and Ornamental Wrought Iron[5] (20).
For Girls—Clay Modelling and Wood-carving[5] (20). Science of Cooking and Cleaning[5] (20).

Third Year.

I. Academic Work—

Literature—(a) German[3] (40). (b) English Literature and Composition[2] (40).
Mathematics—Algebra completed[5] (10). Plane and Solid Geometry[5] (30). Mensuration.
Science—Physics of Heat, Light, and Electricity[5] (20). General Chemistry[5] (20). Structural Botany[5] (20).

NOTE.—Girls take Physics for first half and Botany second half year.

II. Manual and Art Work—

Drawing[5] (40)—Building and Construction[5] (20). Mechanical Drawing or Architecture[5] (20).

NOTE.—At the middle of the third year a choice is offered between a course of Mechanical Drawing or Architecture, extending through the remainder of the student's course.

For Boys—Wood Turning and Pattern-making[5] (20). Moulding and Foundry Work[5] (10). Vice Work[5] (10).
For Girls—Chemistry of Food and Science of Nutrition[5] (20). Millinery and preliminary work in Dressmaking; water colours, drawing in connection with millinery and designs for embroidery[5] (20).

Fourth Year.

I. Academic Work—

Literature: German[5] (40). English Literature[2] (40).
Mathematics—Review Algebra and Geometry[5] (10). Trigonometry and Surveying[5] (10). Field Work in Surveying[2] (20).
Science—Analytical Chemistry[5] (20). Electrical Engineering[5] (10). Photographic Science and Engraving[5] (10).

II. Manual and Art Work—

For Boys—Mechanical Drawing or Architecture.
For Girls—Charcoal Drawing from the Antique. Theory of colour. Pen and Ink work—Copies and from life, for expression of taste and form in designs, for Dressmaking. Designs for Book Covers and Illustrations.
For Boys—Machine-shop Practice[5] (40). Steam Engineering[5] (6).
For Girls—Household Sanitation; Study of Yeasts, Moulds, and lower forms of life; Home Nursing[5] (20). Dressmaking[5] (20). Psychology in place of Electrical and Civil Engineering.

CHAPTER XXIV.

CHAPTER XXIV.

Manual Training Schools of Canada.

[J. W. TURNER.]

In the month of August, 1900, John Seath, Esq , B.A., High School Inspector, Ontario, Canada, was directed by his Government to visit and report upon the Manual Training High Schools of the United States, and to consider and report upon the present High School courses of study, with suggestions regarding any desirable improvements. In February, 1901, he handed in his report, containing the result of his special investigations, and of his own experience as inspector and teacher.

Among the younger nations of the world the Dominion of Canada is at the present time occupying a very foremost position, and its national policy of progress and development is one which commends itself to those who would learn.

In many respects our national life approximates closely to that of Canada. Canadian boys have many of the characteristics and much of the sturdiness of Australian boys, the same feeling of patriotism is inculcated, the Union Jack is honored alike in the schools of both lands, and we feel that what would prove of advantage to the one would certainly be beneficial to the other.

Within the last few years an educational awakening has affected Canada, and the Government has sent its officers abroad with a view to discovering what changes were necessary in the educational methods of the country. One of the very first matters to receive attention was the technical work of the primary and secondary schools.

The splendid benefactions of the late Sir William Macdonald in the establishment of manual training classes in several of the public elementary schools of the Dominion, already referred to in Chapter XVIII of the Interim Report, have greatly assisted the work of the Education Department.

The chief points of Mr. Seath's report—those which it is thought will be of service to this State—are here set out.

(a) The Swedish and the Russian Manual Training System as seen in America, discussed.

"As I have already said, no general system has yet been evolved between the kindergarten and the wood-work of the higher elementary grades. The same remark applies, in a measure, to the exercises in wood-work, owing, I think, not so much to the difficulty of the problem, as to the fact that they came to this Continent from two sources—Russia and Sweden. The main differences between these two systems in their original forms were that the Russian emphasised the value of the working drawing; the Swedish system, or, as it is called, Sloyd, neglected it, and that Sloyd required each piece of work to be a complete and useful article, whereas the Russian attached no importance to this feature, being, in the earlier part of the course, only so many specimens of joinery. But both of these systems have been modified. Sloyd now emphasises the working drawing, while the Russian exercises have been simplified; and both have been adapted to American conditions. As defined by its advocates, Sloyd is tool-work so arranged and employed as to stimulate and promote vigorous, intelligent self-activity, for a purpose which the learner recognises as good. Its aim—and this should be the aim of any manual training system—is the harmonious development of the pupil during the formative age, giving him by manual exercises and the use of the creative instincts such general training as will fit him mentally, morally, and physically for any subsequent special training. The Russian system assumes that the forms of tools are the product of evolution, being the result of the best thought and the highest skill. Each tool has its functions and its correct methods of use. Again, each material has its characteristics, its limitations, its weak and its strong sides. These must all be brought out, contrasted, and compared. And again, construction consists chiefly in methods of combining pieces; hence, joints, unions, and fittings constitute the chief elements. To a subordinate extent individual parts are to be shaped or modelled in accordance with the laws of simplicity, strength, and beauty. Finally, the muscular strength of the boy's hand and arm, and his ability to be accurate, to be logical, and to be provident, must be duly considered.

"Sloyd, however, has some advantages, especially for elementary classes. It makes less of the tool and more of the child. Its gymnastics are better, and its exercises have a more humane interest. The completed article appeals more strongly to the sympathy of the young than the more formal exercises of the Russian system. The latter are more suitable for High School pupils, especially if the course leads to an economic goal.

"As a matter of fact, however, the character of the models I found in many places varied so much as the result of the teacher's individuality that, although I have often heard the terms "American Sloyd" and "American Russian," many of the systems are eclectic, consisting of what the teacher regarded as the best feature of each. This is, of course, as it should be."

At the Conference of N.S.W. teachers held in April, 1904, a resolution was carried affirming the desirability of making Sloyd work the basis of manual training in our public schools. Many think it would be well, before making any final decision in the matter, to submit the whole question of a suitable manual training course in our schools, whether Sloyd or Russian, or some modified form of both, to a body of experts. Mr. Seath's article, at any rate, is well worthy of consideration.

(b) The Argument for Manual Training.

"Here it will be well to summarise the arguments for manual training as a necessary element in all education:

"(1) Theoretically, manual training is necessary. As Froebel as shown, education consists in developing all our faculties fully and naturally. To use the language of the Froebellian: 'We must put the whole boy to school.' It develops a large area of motor brain-energy which the old departments left untouched.

"Our

"Our populations are fast becoming urbanised. The boy and the girl on the farm or in the village still get this training in a haphazard fashion, but the time has gone by even in Ontario when such home-training was general; for the bulk of our school population it is no longer available. Besides, every child enjoys creative work. Drawing, itself a limited kind of manual training, is the only other subject we have which recognises the craving.

"(2) Experience is in favour of manual training. Those who have to do with it all testify to its value:

"(*a*) As an intellectual stimulus. Psychology tells us that, when we develop the motor activities, we stimulate the sensory and other brain areas. It comes, too, as a rest and agreeable change from the purely intellectual, and is thus a help rather than a hindrance to the regular class work. Manual training helps any boy—the dull boy, in particular—in his other studies.

"(*b*) As a social influence. It is itself labour, and its presence in a programme dignifies labour. The professional man is better for it, and it counteracts the present tendencies to despise manual labour—agriculture as well as the trades—and to crowd the professions. Schools in which book studies are the only or the chief ones make the pupils discontented with occupations in which bodily labour plays an important part, and incite them to leave their rural home for the city and the genteel occupations.

"(*c*) As a moral agent. It cultivates habits of independence, originality, self-control, accuracy, observation, truthfulness, taste, and neatness. Children engaged in trying to give material expression to some form of usefulness and beauty, grow themselves into unconscious goodness. It seems also to hold many in school who would otherwise lose interest and drop out for all sorts of frivolous reasons.

"(*d*) As a preparation for manual occupations. While it does not aim to prepare for the trades, it is the best practical preparation that can be given. Even the ability to read and apply the working drawing is itself of very great value. For the various minor duties of life, requiring manual skill, it is equally valuable. What more useful household accomplishment can there be than 'handiness.'

"(*e*) As a physical gymnastic. Exercises like sawing and planing develop the larger muscles, while the smaller ones are developed by the more delicate work of drawing, designing, and finishing. Sloyd, in particular, attaches much importance to a correct position at work."

In connection with these summarised arguments, the Commissioner would again emphasise the views of another Canadian educationist, J. L. Hughes, Esq., Inspector of Schools for the City of Toronto. (*Vide* Chapter xviii, Interim Report.)

The Economical and the Educational Aspect of Manual Training Discussed.

"But my report is concerned mainly with manual training in its relation to primary and secondary education. As the question has been presented to us in Ontario, it has two aspects—the economic and the educational one, the former being in the minds of most by far the more important. The problem we have now to consider is: What can we do to improve the condition of our industries, and at the same time to secure a needed change in our system of education?

"As to the economic aspect: In order that my report should deal with facts, so far as I could ascertain them, I requested the high school principals in the manufacturing and other centres of population to investigate the situation in their localities. I have received answers from about forty-five. In many cases definite numbers were not procurable; but enough was given to show the situation. In the case of Ottawa and Toronto, owing to their population, and the variety and number of the manufacturing establishments, I have been unable to obtain any definite particulars, but I have obtained enough to justify me in concluding that the conditions there are largely the same.

"The general conclusions I draw from the answers are as follows:—

"1. Under present circumstances, extremely few High School pupils from any of the forms—not, I believe, 5 per cent. of the total attendance—enter the manufacturing establishments in any other capacity than that of clerks or office hands.

"2. Of those that enter from the Public Schools, and they are quite numerous in the manufacturing centres, with few exceptions they go from the fourth form, and in many—most, I fear—of the localities outside of the largest centres they leave school before they have completed the studies of the form. Such pupils are often reported as remaining at school only until they are old enough to begin work. The following illustrates the situation: In Hamilton, four left the Collegiate Institute last year for the factories; 140, the public schools (not including those from the separate schools); in Toronto Junction, of those now in the factories, nineteen are from the high school and 129 from the public schools; and in Lindsay ninety per cent. of all the hands have come from the public schools, the remaining ten per cent. being about equally divided between old countrymen, and Canadians who have had a short course at the Collegiate Institute.

"(3) Manufacturers generally, having in view, of course, the industrial aspect of the question, favour the introduction of manual training into the public and high schools. Some of them hold that we shall then retain the pupils longer in our schools, and thus supply a better educated and more useful class of workmen. Many complain of the lack of education and trained intelligence of the boys and girls that come to them. We have provided in our high schools for the preliminary training of professional men, and we undertake in our book-keeping, our stenography, and our typewriting, to prepare boys and girls for the merchant's office. The latter provision is, of course, technical. To be consistent, they hold we should recognise the industrial occupations as well, especially in view of our enormous natural resources, and the increasing importance of our manufactures. In order to show their appreciation and zeal, some of the manufacturers are prepared to give the preference in employment to those pupils who have had this kind of training.

Opinions

Opinions of Ontario Principals.

"I quote a few passages from some of the answers I received, which show the general situation :—

The manufacturers seemed to think well of manual training, one furniture man saying that a course of wood-working would keep away from him some that can never learn his trade. Another in the same line said that the boys he employs are in many cases hampered by their imperfect knowledge of fractions. As the boys are usually about fourteen when taken on, the question arose, why did they not know fractions? The answer was that they had left school years before, and had been hanging about home. Mr. Cairnes said that in cutting out gloves what he mainly wanted was intelligence, showing me how a former pupil of mine cut 785 square inches of gloves out of a skin which was reckoned enough for 752 inches, while a bad or rather a stupid hand got 44 inches less than had been expected out of a somewhat larger skin.

Few of the manufacturers seemed to have any idea to what extent they employed public or high school pupils. Many workmen here are Germans or Poles who came grown up. Largely, boys are set to tend machines.

As said before, manufacturers favour manual training, and drawing to scale. The Public School principal thinks that the time could be spared if the Entrance Examination, with its excessive memorising, were done away with. To me it seems a question turning mainly on the readiness of the Provincial Government to pay expenses. High School boards are hard enough put to it already for funds.—*Prin., Berlin High School.*

About 30 per cent. of the boys who enter the High School attend about one or two years and then find employment in the factories of the town.

A considerable number of boys from the Public School never enter the High School, but find employment in the factories. These boys either run machines, or act as assistants to men who run the machines.

About 20 per cent. of the boys from the Public School never even enter the senior fourth class. After discussing the question with our manufacturers, the principal of the Public School, and some members of our Board of Education, I do not hesitate to say that manual training in our Public or High School is quite practicable and desirable. If some of the subjects now on our school course, which are of no *practical* value to these boys, could be dropped, and manual labour substituted in their stead, I think we would be able to hold many of these boys and girls one or two years longer at school. This in itself would be worth much to them. If this change in our school course could be effected, the large number of unskilled labourers which we now have would be replaced, in time, by intelligent master workmen who would have a 'why for every how.'—*Prin., Gananoque High School.*

All of the proprietors thought that manual training should be taught in the schools, so that boys might, at an early age, say at 13, begin to acquire skill and knowledge of tools and machinery. After such a preliminary training they could more intelligently decide what calling or department of work to follow. A course of this kind would also keep the boys longer in school, and their literary training might go on simultaneously with the mechanical drills.

Mechanical drawing was warmly advocated.—*Prin., Chatham, Collegiate Institute.*

I have had many requests from boys just entering the Collegiates to be allowed to dispense with some of the obligatory subjects and take electricity and some chemistry, but on account of the regulations I could not allow that. I sometimes think that when a boy enters the C. I. and has only a short time to remain, and knows that he is going into some electrical works, he should be allowed to take a course that would more directly fit him for the object he has in view.—*Prin., Guelph Collegiate Institute.*

A school for manual training would be popular in Galt and would be well attended. Parents would be able to find out whether a child has any liking or aptitude for a trade, and manufacturers say that such apprentices would be more intelligent and would not waste so much material. No greater boon could be given to this district. It is only a question of funds.

The question of opening a school for the teaching of Domestic Science in Galt is to be discussed within a few days by a joint committee from the Collegiate Institute Board and the Public School Board.—*Prin., Galt Collegiate Institute.*

The boys from the High Schools rarely learn a trade. The employers say they often come from the street, having driven wagons, &c., after leaving the Public Schools. I believe working in wood, metal, with drawing, eminently practicable; moulding is of less value. All the great employers, as Leonards, McCleary's, Yates (of London Tool Co.), are enthusiastic about the matter. They would give the positions to boys who had taken the course in preference to others. They are very desirous of obtaining a more intelligent class of apprentices. There is a strong feeling among the manufacturers in favour of Manual Training. They think it should be in connection with High Schools, as boys should begin about 12 years of age. London is largely a factory town, and our High School is doing very little for those entering into trades. —*Prin., London Collegiate Institute.*

The manager of the Sylvester works is very strongly in favour of having manual training in the Public Schools. He thinks it could be begun in a simple way and gradually lead to more difficult work, and that the young mechanics of this country would be worth two or three times their present value if they had some training in school. He says that very few of them will go to Technical Schools after they have left school and been at a trade for a few years, and that in consequence the ordinary factory hand knows only enough to run his own machine. He thinks this would completely change if manual training were taken up in the Public Schools. The Chairman of our Board has given some thought to this phase of education, and thinks that the Government should establish for trial in a number of schools in the larger towns manual training as a feature of the Fifth Form work of the Public Schools.—*Prin., Lindsay Collegiate Institute.*

In answer to your inquiries as to the practicability of introducing a Technical Education course into our schools, we would say that we have greatly realised the need of it. We find that, as a rule, our apprentices come from the Public Schools, and have no idea at all of the different branches of our trade, viz., cabinetmaking, carving, finishing and upholstering, and for some time are of little or no value. Consequently their wages are small, and this brings us an inferior class of apprentices. If they had been taught even the first rudiments of their trade they would be for more valuable to us, and we could afford to pay them higher wages; and this would overcome a great drawback in developing our manufacturing industries. Such a course in our schools would no doubt bring to light great abilities in mechanical lines now lying dormant.—*Letter to Prin. C. I., Ingersoll, from the Ellis Manufacturing Co.*

The apprenticeship system has almost passed away, and manufacturers find it harder to secure boys for shop work than formerly, though there is no lack of boys who wish to take up office work. Several gentlemen assured me that boys with a good English education such as a High School gives could earn more and advance more rapidly in the shops than in the office. Indeed, one gentleman, who employs between 400 and 500 men, told me that all his foremen are Americans.

There is general feeling among the manufacturers I visited, and the Public School authorities I saw, that a course of manual training in the schools would be productive of much good, in turning the attention of boys away from the professions and directing them to the manufactures, where, it is stated, most of the prizes now lie. Most of them emphasised the value of a sound English education, coupled with a knowledge of the use of tools, and the ability to apply that knowledge in practice. All thought the High School the place to give manual training, as the Public School pupil is too immature to profit by it. That a course in manual training would attract pupils to the High School I have no doubt. That such a course could be added to the present curriculum I have no doubt. The chief difficulty in establishing such a course would be in inducing boards to spend the money necessary to put up the requisite buildings and equip them properly.—*Prin., Woodstock Collegiate Institute.*

I have consulted with the superintendents of the various manufacturing works as to the education and knowledge that a boy should have in order that he may become an expert workman. The answers are briefly summarised in this way: In constructive works, apprentices should have ability to perform the simple operations of arithmetic with quickness and accuracy; they should also have command of algebra, trigonometry, and geometry, as they are applied in the practice of mechanical and physical work, and should know thoroughly the physics of machinery and mechanics. Mechanical drawing, inclusive of free-hand, is also a necessity. A knowledge of tools, their adjustment and uses, such as comes from practice with them, and an acquaintance with common machines, their method of working, their driving, gearing, and adjustment will prove of great service to the boy, and will be a means of hastening his promotion to positions more lucrative both to him and to his employers.

In the textile works, the remarks about machinery and tools also apply, but the mathematics are not so important, unless the boy wishes to learn the machine shop practice, which is now a part of most large factories, in order that he may be able to repair or alter pieces that require such attention.—*Prin., Kingston Collegiate Institute.*

The

The one great complaint I found among the manufacturers and master mechanics was the need of better educated boys to learn the trades. Mr. Patterson, superintendent of the G.T.R. shops, showed me a package of answer papers he had examined, and, though the candidates were over 15 years of age, their attainments were of a low grade. In every case the employers complained almost bitterly of this lack on the part of their apprentices. I was told of a boy who had difficulty in writing his own name. In another case an employer found that one of his men—a comparatively young man—could not read. In many instances boys are found who read and write with much difficulty.

Whether the conditions will be found the same in other centres as they are here I am not prepared to say, but it is a deplorable fact that boys should begin their life-work so poorly equipped as I find them. There can be no doubt that parents who intend their boys to become mechanics, and as a consequence the boys themselves, place very little value on a fairly good education. The argument is urged: 'My son is to be a mechanic; of what advantage will it be to him to get more than the merest elements of an education?' To assist in remedying this state of things seems to me to be the prime duty of our secondary schools; to recognise in our system the need of preliminary training for those boys who are looking to the trades for an occupation; to increase the intelligence of the mechanic by keeping boys who are to become blacksmiths, carpenters, &c., longer at school than they remain at present; and to give them considerable scientific and some practical acquaintance with the subjects to which they are to devote themselves.—*Prin., Stratford Collegiate Institute.*

"I submit also the opinion of one of our ablest and most experienced Principals: he sounds a note of alarm that deserves attention:—

"In the lower grades of the P.S., where both girls and boys do the same work, paper work, drawing, carving, I suppose it could be done here as well as in Toronto. After that, when boys and girls have to be separated, the difficulty is the expense. A new room for each would have to be built, and a teacher of carpentry, and a teacher of domestic science engaged. It seems to me the same difficulty would present itself in the High School. There is not a vacant room in either High or Public Schools. In fact, the trustees may have to build new rooms for Public School accommodation this year. Many grumble at the expense of the schools now. I am sure the addition of manual training such as will be of any real use will largely add to the burden. There is no doubt it can be done, if people will stand the expense.

"I may be wrong—I have never seen manual training or domestic science taught—but it does seem to me the world is demanding more and more of the teacher every day. Where do the parents come in? Have they no responsibilities any more? What are the mothers of the land doing if they cannot teach their little daughters sewing, cooking, &c.? Do fathers no more teach their boys to make little articles? It seems to me the age is an age of *babies* that have to be *taught everything*. Cannot they do anything themselves? Is the whole responsibility to be thrown on the teachers? We are to teach them religion, so say the preachers; teach them to cook, sew, scrub, iron, &c., says Mrs. Hoodless and her followers; if a Toronto judge finds a bad boy, the teachers are not doing their duty, &c. Where does the parent come in?

"Another difficulty is the different employments carried on in our towns. In Germany and England, and some of the cities of the United States, the whole population is employed at one trade, glove-making, shoes, weaving, &c. It is an easy matter to furnish training for one particular trade, but what can technical training do in a town like this?

"In industrial schools manual training is excellent and indispensable; in large centres of population both manual training and technical schools are possible, but I fear not in our small towns."

"As to the educational aspect generally: Most of the High School Masters and the Public School Inspectors and other educationalists in Ontario with whom I have corresponded or discussed the subject are in favour of giving domestic art and manual training a place in our school course, provided always that the obstacles which I will discuss further on—the initial cost, the lack and cost of teachers, want of accommodations, the already crowded curriculum, examination pressure—can be satisfactorily overcome. There are, of course, some educationalists and others so imbued with the spirit of the old humanities that they can see no value in this training. Some, not without reason, dread the taint of commercialism and the impairment of our present system. Others, again, sometimes through thoughtless prejudice, and often through self-interest, deride the whole subject. We may hope, I trust, that there will be no just ground for the fears of the former. The latter, like the poor, are always with us.

Recommendations.

"In view of the situation in this province I have to recommend:—

"(1) That, for educational purposes, manual training, including instruction in domestic science and art, be placed on a par with the other subjects on the programme of both the high and public schools. These subjects should, of course, be optional; for it will be many years before public opinion and our resources will justify the action of Massachusetts with its obligatory law. Here I would say that, in the large majority of schools, the only available form of manual training will be drawing; and, as I will point out further on, the course in this subject should be enriched and amplified, to develop more fully the æsthetic sense and to meet our economic requirements.

"(2) That, for economic purposes:

"(*a*) A system of evening classes for artisans and others be organised and put in an effective condition. For the actual mechanic, this provision would always be an important one.

"(*b*) That provision be made in our high school regulations for extending the educational manual training into courses of a technical or semi-technical nature, forming departments in our existing schools, but taken, when possible, in separate high schools. And all such provision should be of flexible character, so that, as the character of our cities and towns becomes differentiated from year to year, school boards may adapt the details to local conditions; but no such provision should fail to recognise the paramount importance of a good academic education in English, science, and mathematics.

"An important proviso I must add—and in view of my experience and of my knowledge of the situation I cannot emphasise it too strongly—*the Education Department should sanction no provision for manual or technical training of any kind at the expense, even at first, of our existing courses.* Notwithstanding all that can be said in behalf of the practical, the claims of the academic must always be paramount.

"The German system of education, as we have seen, draws a sharp line of demarcation between general and technical education, and, consequently, approaches closely to what an ideal system should be. The better the division of labour, the better the product. But Ontario is not a wealthy and populous community, and in many respects she resembles the United States more closely than she does the German Confederation. The American system, which connects the educational training of the elementary classes with the technical training of the high school, is within our reach, and is likely to suit our conditions.

"A few words as to the order of urgency. As is shown by the answers I received from high school principals, even from the utilitarian point of view, it is the public schools that should first and chiefly engage the attention of the Education Department. This is the source whence come most of those who enter

enter the manufactories. The supply often produces the demand, and the high school often deserves attention; but it is to the public school, for some years, at any rate, that we must look for most of our artisans. Every educational consideration also enforces this view. Psychology tells us that it is when the child is in the formative stage—when he is in the elementary school—that the development of the motor centres of the brain should be begun.

"But we cannot expect much at first, and it would be most unwise to force the pace of public opinion. The new subjects were introduced into the United States nearly a quarter of a century ago, and though good progress has been made, what has been done is meagre with what remains to do. In Ontario all we can expect for some years is sewing in most of our public schools, and cooking in the cities and towns, both being continued in some of the high schools. Manual training we may have, sometimes of a simple character, in our city and town public and high schools, with technical extensions in a dozen or so of our largest high schools and collegiate institutes."

(e) Obstacles in the Way of introducing Manual Training.

"But, as the answers I received from principals show and my own experience as inspector leads me to believe, there are very serious obstacles in the way of the introduction of manual training into our school system. Apart from difficulties arising out of our present organisation, which I will discuss in the second part of my report, and which, I may say, are, I believe, not insurmountable, there are two main obstacles—the cost and the want of competent teachers.

"(1.) As to the cost. For sewing, all that is needed is competent teachers; but, for cooking and manual training in wood and iron, special equipment and separate accommodation are needed as well. As to the equipment, I submit a conservative estimate of the cost of a room filled up in good style for a class of twenty in cooking. This number Miss Norris, the principal of the Toronto Victor School, to whom I am indebted for the estimate, regards as the largest a teacher can manage efficiently at one time:

	$
20 desks, each fitted with full length drawer and stand; $6·00 each (set up)	120·00
20 stools, with rubber tips, 60c. each	12·00
1 dish and utensil cupboard, 7 feet 6 inches long and 7 feet high, with seven drawers, 5 sections, shelved	40·00
Utensils and dishes	75·00
1 range, with warming closets	35·00
1 sink iron enamelled with back	15·50
2 sink tables, $4·00 each	8·00
Linen for towels	10·00
	$315·50

"Cupboards to be ash; desk and tables, ash body birch top; bunsen burners and a number of minor necessities are omitted. Refrigerator not included. No provision for children's aprons are mentioned, as such provision may or may not be needed.

"In a good many cooking schools I visited, there were several ranges—one for coal, one for gas; and, occasionally, one for electricity; the object, of course, being to accustom the pupils to the different kinds.

"For the following statement of the cost of a "shop" for wood-working, I am indebted to the official report of the Kingston C.I.; it includes the cost of the drawing department:—

18 drawing-tables, at $4·25	76·50
36 drawing-boards, at 60c.	21·60
18 sets drawing-instruments, at $8·75	157·50
Miscellaneous drawing-instruments for demonstration and occasional use	53·00
18 wood-working benches, with quick-acting, vise, at $17·25	310·50
18 sets bench tools for students' use, at $11·14	200·52
Miscellaneous wood-working tools for demonstration and occasional use	53·00
Fitting up the workshop	140·00
	$1,012·62

"For High Schools that would attempt courses in hot and cold metal, as well as in wood, the cost would be much larger. What it would be, even in a modest way, may be gathered from the following statement of the value of the building and equipment of the department in Woodstock, which provides for two classes of twenty-four each in wood and one class of ten in iron-work:

	$
Building, brick 2½ storeys 30 x 80 feet	2,500
24 Carpenters' Benches at $12·50	300
24 sets of tools at $15·00	360
24 Wood Lathes at $30	720
Shafting, Belting, &c.	650
Wood carving Benches for 24	120
24 Sets Carving Tools	100
Special Tools for occasional use	150
Wood Working Machinery (Planer, Circ. Saw, Scroll Saw, &c.)	400
10 horse-power Gas Engine	750
Blacksmithing outfit for 10	300
Machine Shop Tools for Iron-work	2,500
Small Tools for Machine Shop	200
	$9,050

"For the following particulars I am indebted to Prof. Robertson, of Ottawa, who has charge of the Macdonald Manual training fund; the statement gives the cost of fitting up one of the manual training rooms.

"The Manual Training equipment, benches and tools, for a 20-bench centre would cost, at prices we have been paying, about $400·00. The fitting of the room with cupboards, general tool racks, &c., would cost about $300·00 per room. Sometimes that cost of $300·00 per room has been exceeded when it has included the cleaning up and painting of the room.

"One teacher can take charge of a single 20-bench centre suitable for twenty boys. Taking twenty different boys every half-day permits the centre to deal with 200 boys per week.

"The

"The following is the list of tools that have been provided:

For the Room.

5 Smooth Planes.
3 Fore Planes.
8 Round Head Mallets.
1 Draw Knife.
1 Mitre Box.
2 Try Squares.
4 File Cards.
8 Screw Drivers, small.
2 Screw Drivers, large.
1 "T" Square, each 4 in. and 5 in.
8 Flat Files, 8 in.
8 One-half Round Files, 3 in.
2 S.T. Files, 4 in., and one handle.
2 Flat Files and one handle.
4 Bit Braces.
1 Flat Plyer, 5 in.
1 Round Plyer.
2 Oil Cans.
2 Centre Bits, each $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$.
1 Auger Bit, each $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, and $\frac{3}{4}$.
4 Drill Bits.
2 Screw Driver Bits.
2 Wood Counter-Sinks.
1 Iron Counter-Sink.
5 Oil Stones.
1 Rabbet Plane.
10 Hammers.
2 Firmer Gouges, each $\frac{1}{2}$, $\frac{3}{4}$, bev. inside.
2 Firmer Gouges, each $\frac{1}{2}$, 1, $1\frac{1}{4}$.
2 Mortise Chisels, each $\frac{1}{4}$ and $\frac{3}{8}$.
5 Bevels.
5 Nail Sets.
8 Wood Spoke Shaves.
4 Hand Screws.
10 Brad Awls, assorted handles.
2 Doz. Brad Awls, not handled.
2 Slips for Gouges.
8 Scrapers.
4 Mort. Gouges.
4 Wing Dividers, 5 in.
4 Pincers.
1 Cutting Plyer, 5 in.
2 Chisels, $\frac{1}{16}$.
4 Firmer Chisels, $\frac{1}{8}$.
2 Hatchets.
1 Pad Saw.
1 Grind Stone.
4 Rip Saws and 4 Cross Cut Saws.
6 S.P. Corks.
2 Spg. Dividers.
3 Cutting Gouges.
5 Gimlets.
1 Tool Grinder
2 Bent Gouges, 15 each $\frac{3}{4}$ and 1.
2 Blackboard Compasses.

For the Bench.

1 Rule.
1 Drawing Rule.
1 Sloyd Knife.
1 Gauge.
1 Try Square.
1 Jack Plane.
1 Firmer Chisel, each $\frac{1}{4}$, $\frac{1}{2}$, 1.
1 Bench Hook.
1 Pencil Compass.
1 Back Saw.
1 Marking Awl.
1 Drawing Kit.
1 Brush and Hook.

"Under the MacDonald system, I may say here, the boys have one session each a week, lasting the whole forenoon or afternoon; the girls of the corresponding classes in Brockville during these periods taking under the regular teachers, sewing, knitting, and cutting-out, and listening to talks on Domestic Science. In the opinion of Mr. Robert Meade, P.S.I., of Brockville, from whom I have learned these particulars, the sessions are too long and much better results would be obtained if each pupil had two, each $1\frac{1}{4}$ hours long. By the present plan, the pupil is completely tired out bodily and mentally. Besides, the sessions are so far apart that he has forgotten much of his previous lesson and his interest in his last piece of work has been gradually fading away. In Mr. Meade's estimation, the 'Centre' system is to blame for this. In the elementary schools I saw in the United States, the time given to Manual Training varied from an hour once a fortnight to three hours or four hours and a half a week, the latter provision being regarded as the best one.

"Nor, in counting the cost, can we ignor the important fact that very few of our schools have accommodation to spare, and the equally important fact that the cost of the present system is, in most localities, as great as the taxpayer is prepared to meet, until, at least, this subject is more generally understood. And, further, I can think of almost no High School in Ontario, and this is true, I believe, of the Public Schools as well, which, to do full justice to both the staff and the pupils, does not need additional teaching power for the existing courses. Many of our classes are far too large, and many of our teachers are sadly overworked. We must be prepared to do a good deal more than simply add the new subjects to the programme.

"(2.) As to the lack of competent teachers. Notwithstanding the provision for training teachers that has been made in the United States, this is still a serious obstacle there, and for some years it will be a very serious obstacle in Ontario. The Hamilton and Toronto Schools of Domestic Art with their normal classes are fortunately ready to hand. All that is needed is the demand. But, for Manual Training, no similar provision has yet appeared. Kingston had to import a teacher from the United States at a salary which few boards would care to pay, and the MacDonald Schools are manned by teachers from England. True the latter schools provide instruction for the teachers of the locality, and a summer school was opened last year; but is the product of such classes likely to be satisfactory in view of the fact that the courses in the United States schools take at least one year, and oftener two? This phase of the question is a most important one. All the educationalists I have met are unanimous on this point. Mr. R. M. Smith, Supervisor of Manual Training in Chicago, who has made a special study of this subject, expresses an emphatic opinion. 'Manual Training stands or falls with the character of its representative. I should recommend that great care be taken in its introduction, otherwise we shall bring the new branch into disrepute, and, when a thing of this kind is tried in a community with failure as a result, it is very hard to reinstate it in the minds of the people.' As to technical evening classes: only in the University centres—Toronto and Kingston—could competent teachers be secured without, as in Germany, drawing upon the staffs of the High Schools or Public Schools. But, as matters stand, it would be unreasonable to expect our teachers to do the work of the evening classes in addition to the work of the day school. To do so would be to sacrifice their own health or the interests of both classes of schools. A special grant to School Boards concerned might overcome the difficulty by enabling them to increase their staffs and thus relieve one or more of part of their day duties."

(*f*) Recommendations to overcome said obstacles.

"In order to assist in overcoming these obstacles, I beg leave to recommend as follows :—

"(1) The Education Department should take steps to provide a supply of competent teachers. The expert mechanic as I have already pointed out will not suit. The industrial side of the question is important, but the educational side is more so, and, even for the technical departments, we need the trained teacher. The difficulty may be tided over for a year or so by importing foreign teachers; but we must look to Ontario for a permanent and effective supply. All our teachers must be 'to the manner born.' From the nature of sewing, it may form part of the course in our normal schools, and before long in our remodelled model schools. As to cooking, it should at first be an optional course in the Hamilton Normal College. The Ontario Normal School of Domestic Science and Art is available. All that is needed is a departmental regulation to set the machinery in motion. In Toronto we have also the Victor School, and no doubt before long facilities of a similar nature will be available in London and Ottawa. These cities cannot lag behind, even if no action is taken in the matter by the Education Department. In this way eventually provision can be made for all the normal schools as well, even if the Education Department itself does not act. Under present conditions a normal course of four or five months may have an educational value; but it is insufficient preparation for teaching. For a time the Normal College would, I believe, produce a sufficient supply. As to manual training, for some years the demand for teachers will be small. If an arrangement were made for the establishment of a Manual Training Department in the Hamilton Normal College (which might also be a city public school centre), our requirements would be met for some years, at any rate.

"Provision in our professional courses is an absolute necessity. The first step in Sweden was to make manual training a part of the normal school courses. There is no State system in the United States; but this was also the recommendation of the Massachusetts State Commission appointed in 1891 'to investigate the existing system of Manual Training and Industrial Education.' And, as has been shown, such provision exists in some of the normal schools.

"(2) In view of the importance of Domestic Science and Art, and of Manual Training with its technical extensions, the Legislature should for a time stimulate their introduction by a special grant, proportioned in each case to the magnitude of the undertaking, and limited only by its liberality and a due regard for other departments. The MacDonald Schools are to be maintained for three years. The Legislature of Ontario might fairly give its special grants for that time at least. Afterwards any sum voted should be apportioned on the same bases as is the present legislative grant—on the character of the accommodations, the value of the equipment, the average attendance, and the amount of the salaries paid the special teachers. The percentage at first allowed might be larger than that given under the scheme for distributing the present grant; but it should be gradually reduced as the subjects commended themselves to the people, until Manual Training and Domestic Science and Art are placed where they should be—on the same footing as the other departments of school work. Only special considerations can justify special grants. The utilitarian value of sewing and cooking will no doubt commend them before long to most school boards; but with Manual Training, the case is different. As to the technical evening classes, I have already suggested a special grant."

CHAPTER XXV.

Evening Continuation Schools in England.

[J. W. TURNER.]

Leeds School Board.—The Evening Continuation Schools in Leeds have for their aim the carrying forward of the education given in the Day Schools, and the preparing of students for profitably taking up the work of the Higher Grade Commercial and Artisan Evening Schools.

The courses of instruction embrace reading, writing, composition, arithmetic (with mensuration), English history, geography (with lantern lectures), ambulance, drawing, singing, woodwork, wood-carving, and clay-modelling; and in addition for girls, cookery, needlework, dressmaking and millinery.

No pupil is admitted under the age of 12 years, and no day-pupils are enrolled. The nights of meeting are Monday, Wednesday, and Thursday. The hours of meeting are—girls and young women, 7·15 to 9·15 o'clock; boys and young men, 7·25 to 9·25. The fee is 1d. per week, or 1s. for the whole session of twenty-eight weeks, payable in advance. Book prizes are awarded. The schools are under certificated teachers of experience, assisted by well-qualified assistants and teachers possessing special qualifications.

At the end of 1902 there were 26 Evening Continuation Schools for boys and young men in the city of Leeds, and 20 for girls and young women. There is also an Evening School for the Deaf, which is intended to continue the education begun at the Board's Day School for the Deaf. Separate classes for young men and young women are held in the Central Higher Grade School, and the syllabus of instruction includes methods of communicating by written and spoken language. Admission to this school is free. Woodwork and wood-carving classes, included in the above lists, are conducted in thirteen Evening Schools. Pupils already enrolled in any one of the Continuation Schools are admitted free to both these classes; other pupils pay 1s. for the session. Clay-modelling is taught at two convenient centres. Pupils from the Board's Evening Schools are admitted free; other pupils pay 1s. for the session. Elementary classes for singing are conducted in seven centres, and intermediate classes in four centres. Evening scholars are admitted free; other pupils pay 1s. for the session. Students in the elementary classes are prepared for the elementary certificate of the Tonic Sol-fa College, and have practice in elementary sight-singing from the staff notation and in voice cultivation. Students in the intermediate classes are prepared for the intermediate tonic sol-fa certificate and first-grade staff notation certificates of the Tonic Sol-fa College, and have practice in voice cultivation.

The scheme of the Leeds School Board regarding Evening Continuation Schools is shown in the subjoined diagram:—

DIAGRAM SHOWING THE ORGANISATION OF EVENING SCHOOLS AND CLASSES.

<table>
<tr><td>Special classes in Commercial and Literary subjects at the Central and Cockburn Higher Grade Schools.
(Two or three years' course).
↑</td><td>Special classes in Technological subjects at Cockburn School and the Leeds Institute.
(Two or three years' course).
↑</td></tr>
<tr><td>Higher Grade Commercial Schools.
(One or two years' course).
↑</td><td>Higher Grade Artisan Schools.
(One or two years' course).
↑</td></tr>
<tr><td colspan="2">Ordinary Continuation Schools.
(One or two years' course).</td></tr>
</table>

Higher Grade Evening Commercial Schools.—At the age of 15 or 16 years, or it may be later, the pupil who has completed his course in the ordinary Continuation School may pass either to the Higher Grade Evening Commercial School or to the Higher Grade Artisan School. If his bent is in the direction of the former, his studies are designed to prepare him for a position in a warehouse, counting house, or similar place of business, as clerk, cashier, bookkeeper, or as general and foreign correspondent. The courses of instruction are of a thoroughly practical character, and include bookkeeping, business methods (commercial correspondence and office routine), commercial geography (illustrated with lantern slides), commercial history, English literature, French, and shorthand. English composition and arithmetic, together with handwriting, figuring, and neatness in setting out work are mentioned as requiring careful teaching by those in charge of the classes. Head teachers are assisted by experienced teachers, who have had a business training in the subject they teach. The school is held three nights a week, two hours each night. The fee is 3d. a week, or 2s. 6d. for the whole session.

There

There are ten Evening Commercial Schools in Leeds, all being held in ordinary Day Schools. A pupil attending any of these schools has the privilege of joining, free of charge, the following classes:—Singing, clay-modelling, woodwork and wood-carving, and art. After one or two years in the Higher Grade Commercial School a pupil should be fit for transfer to either the Central or Cockburn Higher Grade Evening School.

Higher Grade School for Artisans.—If a boy's inclinations lie in the direction of industrial work he may pass from the ordinary Continuation School to a Higher Grade School for artisans. There is only one Artisan Evening School in Leeds, and it is held in the Jack Lane Higher Grade School. This School provides courses of instruction suitable for youths engaged in engineering and allied trades.

The syllabus includes workshop arithmetic; practical mensuration; elementary, geometrical, and machine drawing; elementary lessons in mechanics; English language and composition; woodwork and metal work. The school is open for three nights in the week, two hours each night. The fee is 3d. a week, or 2s. 6d. for the session.

Central and Cockburn Higher Grade Evening Classes for Commerce, Language, etc.—Specialised courses of study are now introduced. Their object is—"(*a*) to enable persons who are entering upon a commercial career to obtain an intelligent knowledge of the work they will be required to perform during the first few years in a business house; and (*b*) to enable junior clerks and the sons of business men to acquire information which will be of practical use in their work, and the knowledge which it is essential they should possess if they aspire to higher positions. At the present time there is a want of Englishmen speaking and writing modern languages, and thus capable of representing English firms on the Continent, or of conducting home correspondence with foreign houses." A systematised course of study, as appended, is suggested by the Board:—

	First Evening.	Second Evening.	Third Evening.
1st Year ...	1. Book-keeping (elementary). 2. Commercial arithmetic.	1. Business methods (Home trade). 2. Commercial Geography (The Empire).	1. Shorthand (elementary) 2. English.
2nd Year ...	1. Book-keeping (advanced). 2. Commercial History (elementary).	1. Business methods (Export trade). 2. Commercial Geography (Foreign countries).	1. Shorthand (Intermediate). 2. French or German (elementary).
3rd Year ...	1. Accountancy. 2. Commercial History (advanced).	1. Principles of Commerce. 2. Typewriting.	1. Shorthand. 2. French or German (advanced).

Arrangements have been entered into for the students to carry on an interchange of business transactions with the Commercial Schools in other towns, and with several of the French and German Schools of Commerce. The fee for one class is 5s.; for two or more classes, 7s. 6d. A certificate of study is awarded at the end of the session.

The classes in actual working order are:—Book-keeping, accountancy, business methods, shorthand, typewriting, commercial arithmetic, commercial geography, English, French, German, Spanish, Latin. The Central Higher Grade Evening Schools include classes for dressmaking, millinery, and practical cookery.

Cockburn Higher Grade and Leeds Institute Evening Classes.—A lad having completed his course in the Higher Grade Artisan class may pass to either the Cockburn Higher Grade School or Leeds Institute. The subjects of instruction in these places embrace workshop arithmetic, practical mathematics, practical plane and solid geometry, machine construction and drawing, mechanical engineering, applied mechanics, theoretical mechanics, steam and the steam engine, building construction and drawing, brickwork, masonry, carpentry and joinery, hygiene, practical physics, electric lighting, lighting and power transmission, chemistry, physiography, art. The subjects divide into an engineering course and a building-trades course. Certificates of study are issued on the termination of either course. In the Cockburn Evening School provision has been made for instruction in practical cookery, dressmaking, millinery, and sick nursing.

The Birmingham School Board.—In its 1902–1903 prospectus, the Birmingham School Board announces that it is anxious "that the young people of the city should not only retain the knowledge they have already acquired in the Day Schools, but that they should have every facility for carrying on their studies by means of Evening Classes, in the hope that they may be materially assisted in preparing themselves for their future career in life. Adults will be eligible to attend the classes." The classes are held three nights in the week, the lessons each night extending over one and three quarter hours. The Board controls eleven Evening Classes for men and youths, eleven Evening Classes for women and girls, and one Evening School for the deaf.

The curriculum for males embraces arithmetic, book-keeping, mensuration, reading, science, shorthand, woodwork, writing, commercial correspondence and office routine, geography, ambulance, drawing, metal-work, and French; and for females, arithmetic, book-keeping, French, shorthand, needlework,

needlework, dressmaking, vocal music, cookery, laundry work, commercial correspondence and office routine. The subjects of instruction in the Evening School for the Deaf are arithmetic, English language, cookery, needlework.

In these Evening Schools students may take up subjects which will have a direct bearing upon their daily work. In the commercial classes, which are established at every centre, the main object is to provide instruction in those subjects which will specially fit students for commercial employment. The entrance fee is 1s., the whole of which is returned if the student makes 90 per cent. of attendances, and half the fee is returned in the case of those making 75 per cent. of attendances. Pupils with a leaving-card from the Day Schools are admitted to the Evening Classes free. The staff consists of one assistant teacher for every 40 scholars in average attendance. Special classes vary in size from 12 to 20 pupils. It is part of teachers' duties to visit homes of pupils who are irregular in attendance. A system of book prizes prevails.

Scale of Salaries for Evening School Teachers.

1. Head teachers (men), 6s. 6d. per evening, together with one-tenth of all the Government grant earned.

2. Head teachers (women), 6s. per evening, together with one-tenth of all the Government grant earned.

3. Assistant teachers of commercial classes—Men, 6s. 3d. per evening; Women, 5s. 6d. per evening.

NOTE.—Teachers of Commercial Classes are those who devote at least two-thirds of the time in which they are employed in Evening School work to teaching one or more of the following subjects:—Foreign languages, shorthand, book-keeping.

4. Assistant teachers of ordinary classes—Men, 5s. 6d. per evening; women, 4s. 6d. per evening.

5. Teachers of special subjects—Ambulance, medical practitioners, 10s. 6d. per evening; ambulance, other teachers, 6s. per evening; cookery, 5s. per evening; science, 6s. 3d. per evening; science, 4s. per half-evening.

6. Assistants (men) who act as chief assistants in Girls' School shall, for visiting absentees, receive, in addition to the ordinary salary for this class of teacher, 5d. per head on the average attendance of the whole school during the complete session.

Evening Continuation Schools, for men only who do not care to attend classes in the ordinary Evening Continuation School, are provided in four different centres.

The fee is 3d. per week, or 3s. 6d. per session.

City of Manchester School Board.—The Manchester School Board divides its night classes into Evening Continuation Schools, Evening Science and Art Schools, Evening Commercial Schools, Evening Institutes for women and girls; but the co-ordination is not so well defined as that obtaining in the Leeds system of evening work. The groups of subjects in the Board's Evening Continuation Schools are:—

(1) Elementary subjects. (Taken at all schools.)
Reading, recitation, writing and composition, arithmetic.
(2) English subjects. (Taken at certain schools.)
English language, geography, history, life and duties of the citizen.
(3) Science subjects and subjects of practical utility. (Taken at certain schools.)
Elementary chemistry, magnetism, book-keeping, shorthand, drill, drawing.
(4) Vocal music. (Taken at certain schools.)
Tonic sol-fa notation.
(5) Special subjects for girls and women. (Taken at certain schools.)
Domestic economy, needlework, sewing course, knitting and mending course, cookery, dressmaking for the seniors, drill.

Fees:—Pupils under 18 years of age, 2d. per week, or 2s. 6d. per session. Pupils over 18 years of age, 3d. per week, or 3s. 6d. per session.

In Manchester and its immediate suburbs there are 86 Evening Schools—43 for males and 43 for females. Male and female scholars meet in the same building in different rooms, and generally under different instructors.

Evening Science and Art Schools, Manchester.—The control of these Evening Schools with two exceptions has lately been transferred from the School Board to the Technical Instruction Committee of the City Council, and the Evening Science and Art classes formerly held in the Central School are now conducted in the Municipal Schools of Technology and Art. The Board's classes are held five nights in the week, and only a moderate fee is charged. The Head Masters exercise a constant supervision over the various classes, advise pupils on courses of study to be pursued, and furnish reports on the progress and attainments of individual pupils.

In the two Evening Science and Art Schools still under the Board, and held in two Higher Grade Schools, the subjects of instruction are—human physiology, building construction, organic chemistry, practical plane and solid geometry, hygiene, machine construction and drawing, magnetism and electricity, mathematics, physiography, physics, and mechanics. The following groups form the course of study in the Municipal School of Technology:—Pure and applied mechanics, mechanical engineering, architecture and builders' work, municipal and sanitary engineering, physics, electrical engineering, pure chemistry, applied chemistry, photographic and printing crafts, textile industries, dressmaking, art classes, miscellaneous.

Fees—Science.—Fee for session covering five sciences, 5s.; fee for session with practical chemistry, 10s. 6d.; separate subjects, 2s.; chemistry, practical, 5s. 6d.; physics, practical, 5s. 6d.

Art and Design.—Elementary (second grade) subjects, 3s. per session; advanced (third grade) subjects, 7s. 6d. per session; life class, 2s. 6d. extra.

Evening

Evening Commercial Schools.—In the 1902 Directory of the Manchester School Board, the Clerk of the Board points out that the object of these schools is to provide technical instruction in those subjects which meet the requirements of modern business. The scheme has the endorsement of Sir Philip Magnus, who, in his work on "Industrial Education," states "that the organisation in all large towns of evening classes, with a well-arranged programme of studies, is a necessary part of any system of commercial education." The Clerk of the Board adds, "that if the clerks of Manchester are to hold their own against the competition of foreign rivals, opportunities must be afforded them of making up by evening instruction the deficiencies of their early education."

One of the chief objects of these schools is to serve as Continuation Schools for scholars leaving elementary and secondary day-schools, in order specially to fit them for commercial employment, as, *e.g.*, in the counting-house, warehouse, bank, or office. The course also prepares for Civil Service appointments, and for the Scholarships and Exhibitions of the Lancashire County Council. Courses of instruction are given at the Central Higher Grade School for the benefit of candidates preparing for the following examinations :—

Chartered Accountants—Preliminary, Intermediate, and Final.
Incorporated Accountants—Preliminary, Intermediate, and Final.
Institute of Secretaries—Preliminary, Intermediate, and Final.
Institute of Bankers—Preliminary and Final.
Preliminary Legal—Institute of Actuaries—Preliminary.

The Head-masters are assisted by teachers who have had a thorough business training and experience in teaching.

The Board of Education recognises the advanced character of the instruction given at the Commercial Schools, and H. M. Inspectors visit the schools for the purpose of seeing the classes at work, but do not examine. Pupils are encouraged to enter for various competitive examinations.

The following is a complete list of the subjects taught at the Central Evening Commercial Schools:—Arithmetic and algebra, banking law and practice, book-keeping and accountancy, business-training and management, commercial English, commercial geography and history, commercial law, insurance—life, fire, and marine, economics of commerce, handwriting and commercial correspondence, *précis* writing and indexing, shorthand, typewriting, French, German, Danish, Italian, Modern Greek, Portuguese, Spanish, Russian, the life and duties of the citizen, English literature and elocution, political and social economy. Women are admitted to all the Evening Commercial Schools conducted by the School Board. The Board controls ten Evening Commercial Schools.

The Central Commercial Evening School, established in 1889, was the first in the United Kingdom to organise practical and systematic courses of instruction for the special benefit of those engaged in commerce. The school at its inauguration received the unqualified approval of the Manchester Chamber of Commerce, and the practical support of many employers, who, *by the payment of fees, encouraged their employés to join the Institution.* "During the thirteen years of its existence," says the Clerk of the School Board, "the School has earned a high reputation among commercial men for the practical character of its methods and the high standard of its work."

Fees in preparatory department.—Juniors under 16 years of age, three evenings per week, session September to April, 7s. 6d.; session September to July, 10s. 6d.

Classes for men and women, three evenings per week—September to April, 12s. 6d.; September to July, 15s.

Classes for separate subjects intended for those not taking the organised courses have been arranged, and the fees charged are :—

Accountancy and Book-keeping	3/6 a quarter;	6/– half-year;	7/6 session.
Business Training	3/6 „	6/– „	7/6 „
Shorthand	3/6 „	6/– „	7/6 „
Commercial Arithmetic	3/6 „	6/– „	7/6 „
„ English	3/6 „	6/– „	7/6 „
„ Correspondence and Handwriting	4/6 „	7/6 „	10/– „
Algebra (Elementary class)	3/6 „	6/– „	7/6 „
„ (Special class)	21/– course—September to April.		
Elocution and Literature	3/6 a quarter;	6/– half-year;	7/6 session.
Commercial Geography and History	3/6 „	6/– „	7/6 „
„ Law	5/– „	7/6 „	10/– „
Conveyancing	5/– „	7/6 „	10/– „
Contracts, torts, practice	5/– „	7/6 „	10/– „
Language classes (each)	5/– „	7/6 „	10/– „
„ Political Economy	5/– „	7/6 „	10/6 „
Chartered and Incorporated Accountants' Courses—			
Preliminary		21/– „	
Intermediate and Final		15/– „	
Courses for the Institute Secretaries' Examinations—			
Preliminary		21/– „	
Intermediate and Final		15/– „	
Institute of Bankers—			
Preliminary		21/– „	
Final		21/– „	
Life and Duties of the Citizen	2/6 a quarter;	6/– „	
Civil Service Courses		12/6 „	15/– session.
Lecture Courses—Banking, Insurance	2/6 per course.		
Economics of Commerce, Mercantile Law	2/6 for each branch.		

The classes are held every night except Saturday, and the hours are from 7 to 10 o'clock.

Evening

Evening Institutes for Women and Girls.—These were very successfully conducted during the year 1901, being attended by 1,800 pupils over 16 years of age, who received instruction in domestic subjects. The ordinary subjects of instruction are, cookery, domestic economy, dressmaking by tailor-measurement, health lectures, laundry work, millinery, needlework. There are seven Evening Institutes in Manchester, each presided over by a Head Mistress, who is assisted by skilled teachers. The fees are 4d. per week, or 5s. for the session—September to March. Several of the Institutes add English literature and vocal music to their courses.

The latest statistics obtainable with regard to attendances at the different Evening Classes in the City of Manchester show an enrolment of between 17,000 and 18,000 scholars, of whom more than 9,000 are in the ordinary Continuation Schools. While there seems to be little co-ordination in the scheme of Evening Classes under the Manchester School Board, credit must be given for its comprehensiveness and its suitableness to the needs of the population.

London School Board.—The following statistics from a proof sheet for the 1901–1902 report of the Evening Continuation Schools Committee, London, show the extent of the operations of the London School Board in the matter of Evening Classes:—

No. of schools	398
No. of pupils admitted throughout session	133,191
Average No. on the rolls (winter term)	73,796
Average No. present at all (winter terms)	55,238

The schools are classified as ordinary schools, Schools for Senior Students, Schools for Junior Students, and Special Schools—Commercial, Science and Art, Commercial and Science and Art, and Schools for the Deaf.

STATISTICS OF SPECIAL SCHOOLS.

Kind of School.	No. of schools.	No. of Pupils admitted throughout Session.	Average No. on rolls. (Winter terms.)	Average No. present at all (Winter Terms.)
(*a*) Commercial	14	9,830	5,785	4,403
(*b*) Science and Art	6	5,315	3,721	2,613
(*c*) Commercial and Sience and Art	3	4,355	3,070	2,171
(*d*) Deaf	9	403	315	237

The session usually extends from the third week in September until June, but a few schools are continued from June to August. In the summer of 1901, 124 schools and 175 classes—principally for swimming and life-saving—were continued. At the end of the session a large number of the students attending special schools presented themselves voluntarily for examination, and in all cases paid the examination fee charged by the examining bodies. Co-education in the London Board Evening Schools is very general, and the classes are free. The cost of supporting these schools in 1901–1902 was £106,558 18s. 11d.

The different classes, with their methods of working, in the Evening Schools, St. George's Row, Westminster, and the Hugh Myddelton, Finsbury, were carefully inspected by the Commissioners.

CHAPTER XXVI.

CHAPTER XXVI.

Evening Continuation Schools in Scotland.

[J. W. TURNER.]

Introduction.—The splendidly equipped Higher Grade Schools of England and Scotland, and the well organised Upper Primary and Professional Schools of France, afford the pupils of those countries, who remain at school after the compulsory period has elapsed, the very best opportunities for acquiring a very superior kind of primary education. But as the great majority of the children of the working classes leave school between the ages of twelve and fourteen years, Boards of Education have seen the urgent necessity for the establishment of Evening Continuation Classes in order that those compelled to leave the Day Schools at an early age may not be handicapped for the duties of life. In all the large towns of England and Scotland Evening Classes are established, with programmes of work as comprehensive and varied as those in the Higher Grade Departments of the Day Schools. Particulars of the work done in some of the Evening Classes are given in the following pages. The appeal by circular, on the part of the Edinburgh School Board, to parents and guardians of the city is quoted in full as showing the paternal regard evinced by its members in the welfare of those who need the Evening Schools most.

The Evening Schools held in rooms of the Public Schools of New South Wales are generally attended by boys whose early education has been neglected, and in but rare instances does the work exceed elementary instruction. In the Evening Classes, attached usually to the suburban branches of the Technical College, a wider curriculum, embracing drawing and some commercial subjects, is taken.

Apart from our Technical Colleges, these are the only public institutions in our State for continuing the education of our youths who leave school at an early age; and it must be admitted that the provision made for this class of pupils compares very unfavourably with the excellent organisations existing in all the large towns of the Old Country.

SCHOOL BOARD'S APPEAL.

Continuation Schools, Edinburgh School Board, School Board Offices, Castle Terrace, July, 1902. To Parents and Guardians in the City of Edinburgh, *Evening Schools.*—The School Board of Edinburgh deeply regret that so many of the pupils who leave our Day Schools fail to take advantage of the numerous Evening Classes which are open throughout the city, and often allow years to elapse before enrolling in these classes. Good education is not only in itself a source of happiness, but it is essential to advancement in any trade or profession, and a child's education should not be considered as completed when it is found necessary to remove it from the Day School. The work of our Evening Schools is intended to continue and supplement the instruction in our Day Schools, so as the better to fit the pupils for the intelligent discharge of their every-day duties in after life. Year after year the head teachers of our Evening Schools point out the deplorable results of allowing an interval of even one year to elapse before enrolling. Much of what was learned is forgotten, valuable time is spent in revising, and in this way the true work of these classes is greatly hindered. We would, therefore, strongly urge upon you the advisability of sending any of your children who may recently have left the Day School to one or other of the Board's Evening Classes, which open on 22nd September, and of continuing their education there for several sessions. Full particulars regarding these classes will be found in the accompanying prospectus. The Board is anxious in every way to encourage pupils to attend these classes. The Evening Schools meet three times weekly, on Monday, Tuesday, and Thursday. Low fees—repayment of which may be obtained by regular attendance -are charged, valuable prizes are awarded for progress and for perfect attendance, the classes are small so that much individual attention may be bestowed on the pupils, and great freedom is allowed the pupils in selecting those subjects that are most calculated to benefit them in their various occupations.—FLORA C. STEVENSON, Chairman of School Board. ALEXANDER MACKAY, LL.D., Convener of Evening School Committee.

Such was the appeal on the part of the Edinburgh School Board to parents to induce them to continue the education of their children at one or other of the Evening Continuation Schools in that city, and in order that every pupil might know the opportunities afforded by this class of school the prospectus was widely distributed. A copy was forwarded to every pupil who had left during the previous quarter; a supply was sent to each headmaster of a day school for distribution in his district; and the headmasters and the members of the staffs were asked to interest themselves in getting their old pupils, who had left school for work, to follow up their studies at the Continuation Schools. In addition to these means of informing the parents and pupils of what the School Authorities were doing for them, posters, giving full information of the curriculum and the time-table, were placed on the school notice boards of the Day Schools, and in other parts of the city, and numbers were sent to the large business places to be put inside the premises where they could be best seen by the boys and girls at work. One of the most conspicuous objects in entering a Day School in Edinburgh is the notice at the entrance to the buildings, calling attention to the advantages, to those compelled to leave school at 14 years of age, of an Evening Continuation course of studies There is only the highest commendation for a School Board so fully alive to its trust

New

New Regulations.—The new regulations of the Evening Continuation School Code, Scotch Education Department, came into use in 1902. The principal changes effected are the classification of the work into four main divisions, and the qualifications of the teachers. Teachers now have to show that they possess special knowledge of the subject which they engage to teach. The divisions mentioned in the Code are:—

1. Preparatory classes for the completion of general elementary education.
2. Classes for specialised instruction—elementary.
3. Classes for specialised instruction—advanced.
4. Auxiliary classes.

The *Board's Evening Classes.*—Edinburgh School Board, in the winter-session, 1901–1902, had under its control—

1 Elementary School.
9 Schools for young women and girls.
9 Schools for young men and lads.
1 School for young men and women (recently opened).

The total enrolment was 3,431; the average enrolment, 3,136; the average nightly attendance, 95·18 of the average roll. This magnificent attendance was the result largely of a munificent system of money prizes for good attendance, paid into the Savings Bank, and the return of the fee (4s. or 5s.) in the case of all pupils making high attendances. A great point was made of getting the pupils into a Continuation School *immediately* after they had left the Day School.

Elementary School.—The Castle Hill Evening School, attended by 259 children, mainly drawn from the poorest classes of the city and suburbs, is set apart entirely for exempted children. Of these, fifty-five got prizes for perfect attendance, and 163 had their fees returned for regularity of attendance. The percentage of attendance for the session was 94·3. That the Continuation Schools in Edinburgh are popular is evident from the fact that pupils have been known to attend in unbroken regularity for periods extending over five and six years. It is also known that, in the majority of cases, the money won at prize distributions is kept in the Savings Bank. The standard of instruction in Castle Hill Continuation School is elementary in character.

Continuation Schools for young women and girls.—The total number of pupils enrolled in the nine Continuation Schools for young girls and women for the 1901–1902 session was 1,339, and the percentage present of the average number on the roll was 96·7. Causewayside School gave the great average of 98·1, and in none of the schools was the percentage below 95.

The subjects of instruction, other than English, arithmetic, geography, and drawing—elementary and advanced—comprised book-keeping, shorthand, typewriting, French, and experimental science. Industrial subjects, as sewing, dressmaking and cookery, were also taught, while singing and physical exercises formed the recreative subjects.

Special prizes for general excellence were given, and certificates of merit were awarded for attendance, conduct and progress. 701 pupils made perfect attendances, and 1,240 had their fee returned for regularity of attendance. Of the number enrolled, 217 followed the occupation of clerks, message girls numbered 122, dressmakers 119, shop assistants 107, while 478 engaged in home duties.

Continuation Schools for young men and lads.—The total enrolment, 1901–1902 session, in the nine Continuation Schools set apart for young men and lads was 1,833, and the average attendance 94·17. 775 made perfect attendances, and 1,587 had their fees returned for regularity of attendance.

The subjects of instruction were English, arithmetic, geography, history, and in addition mathematics, book-keeping, shorthand, typewriting, mensuration, building construction, machine construction and drawing, and woodwork. Special art classes were carried on in a number of the schools, and instruction given in freehand, model, and light and shade, and also in mechanical drawing. In one school, the subject of steam and the steam-engine was taught.

Special prizes, extra prizes, and certificates of merit, were awarded at the end of the session. Among the occupations followed by these young men and lads were—clerks 279, message boys 275, joiners 145, bakers 21, blacksmiths 23, bookbinders 20, booksellers 20, brass-finishers 24, butchers 26, cabinet-makers 32, electricians 32, engineers 73, grocers 41, masons 43, plumbers 53, printers 75, tailors 41, telegraph messengers, 44.

Of the 3,431 on the rolls for the session 1901–1902—all schools—

896	were 14 years	of age.		148	were 18 years	of age.
855	,, 15 ,,	of age.		81	,, 19 ,,	of age.
609	,, 16 ,,	of age.		29	,, 20 ,,	of age.
371	,, 17 ,,	of age.		52	,, 21 and over.	

The Schools met on Monday, Tuesday, and Thursday evenings—the schools for young women and girls, and the mixed schools at Portobello, from 7·45 to 9·45 o'clock, and the schools for young men and lads from 8 to 10 o'clock. The School Board specially notifies that physical exercises will, if possible, be given in all the Continuation Evening Schools of Edinburgh.

 The

The character of the work covered in the Evening Schools of Edinburgh is shown in the appended time-tables:—

FOR YOUNG MEN AND WOMEN.—PORTOBELLO BURGH SCHOOL.

TIME-TABLE.

Division I.—Preparatory Classes for Completion of General Elementary Education.

	7·45 to 8·30.	8·30 to 9.	9 to 9·45.
Monday	Arithmetic.	Reading.	Composition.
Tuesday	Arithmetic.	Reading.	Composition.
Thursday	Geography (Boys). Needlework (Girls).	Physical Drill (Boys). Geography (Girls).	Drawing (Boys). Physical Drill (Girls).

Division II.—Classes for Specialised Instruction (Elementary).

	7·45 to 8·45.	8·45 to 9·45.
Monday	Arithmetic—Commercial. English. Book-keeping. Shorthand (Pitman's). Typewriting. French. Dressmaking.	Arithmetic—Commercial. English. Book-keeping. Shorthand. Typewriting. Cookery. Drawing.
Tuesday	Same as Monday.	Same as Monday.

	7·45 to 8·15.	8·15 to 9·45.
Thursday	Physical Drill.	Arithmetic (Commercial). English (Commercial Correspondence). Typewriting. Cookery or Laundry Work. Woodwork.

NOTES.

The above Time-Table is subject to revisal to meet the requirements of Pupils.

Pupils who are under 15 years of age and have not gained the Merit Certificate will be expected to devote their attention to Subjects in Division I.

In the English Classes, one of Shakespeare's Plays and the Book prescribed by the Sir Walter Scott Club will be studied.

The instruction in Book-keeping, Shorthand, and Arithmetic will be practical and adapted to business requirements.

The Cookery, Dressmaking, and Needlework Classes will be taught by fully qualified teachers.

The Optical Lantern will be used in teaching Geography.

One or two Social Evenings will be held during the session.

LEITH WALK SCHOOL.

TIME TABLE.

Division 1.—(Preparatory).—Four Classes.

	8 to 8·30.	8·30 to 9.	9 to 10.
Monday	Reading, etc.	Geography *or* History.	Arithmetic.
Tuesday	Arithmetic, Drawing—Freehand	*or* Composition, *or* Geometry.	Drawing—Freehand *or* Geometry.
Thursday	Composition	Geography *or* History.	Arithmetic.

NOTES.

(1) All the subjects mentioned in the Time-table must be taken.

(2) The lowest class will correspond to Standard V.

Division II.

Division II.—(Specialised).

	8 to 9.	9 to 10.
Monday and Thursday	Shorthand (Elementary). Book-keeping (Elementary). Commercial Correspondence. Commercial Arithmetic (Graded Classes). English (Composition, Writing, etc.).	Shorthand (Elementary). Bookkeeping (Elementary). Commercial Arithmetic (Graded Classes). English (Composition, Writing, etc.). French. Commercial Geography.
Tuesday	Mensuration. Commercial Arithmetic. Mechanics. Science (various). Commercial Geography.	English Literature. Magnetism and Electricity (Elementary and Advanced.) Commercial Geography (Graded Classes). English (Composition, Writing, etc.). Commercial Arithmetic.

NOTES.

(1.) Pupils must arrange to attend three evenings per week—two hours each evening.

(2.) Pupils who do not possess a Merit Certificate or a Certificate of Attendance at an Evening School in a previous Session must attend the Classes in Division I.

(3.) The Subjects will be grouped, and each Pupil will require to take the Classes included in the group selected.

(4.) French will not be taught unless a sufficient number of Pupils come forward.

(5.) School Library.—Books given out on Thursday evenings. Printed catalogues may be obtained.

(6.) Shorthand.—Pupils are expected to try the Examination for Pitman's certificate at the close of the Session.

(7.) English Literature.—One of Sir Walter Scott's novels will be read and studied in connection with the Sir Walter Scott Club examination.

Division III.—(For Advanced Pupils who have previously attended any of the Shorthand Classes in the Advanced Department.) They must possess a Certificate of Attendance and Proficiency.

	8 to 9.	9 to 10.
Monday and Tuesday	Shorthand (Advanced) 2 hours. Bookkeeping (Advanced) and Commercial Correspondence.	Shorthand (Advanced). Bookkeeping (Advanced) and Commercial Correspondence.
Tuesday	Reporting Shorthand (2 hours). Typewriting.	Reporting Shorthand. Typewriting.

Division IV.—(Auxiliary Classes.)

Tuesday	Physical Drill.	Physical Drill.

(1) The Physical Drill Class is open to pupils in certain selected groups.

(2) Advanced pupils desirous of Bookkeeping, Shorthand, and Typewriting, will be taught in one group.

Drawing and Technical Subjects.

GROUP *A.* (Elementary) — Freehand Drawing, Shading, etc. (2 hours). Wood Carving (2 hours). Manual Instruction and Drawing to Scale (2 hours).

Architectural Drawing, viz. :—

B. (Elementary) — Building Construction (four hours). Model Drawing (1 hour). Manual Instruction—Building Constrution Models (1 hour).

Architectural Drawing, viz. :—

C. (Advanced) — Building Construction (4 hours). Model Drawing (1 hour). Manual Instruction—Building Construction Models (1 hour).

Mechanical Engineering, viz. :—

D. (Elementary) — Geometrical Drawing (1 hour). Machine Construction (2 hours). Technical Arithmetic (1 hour). Steam and the Steam Engine (2 hours).

Mechanical Engineering, viz. :—

E. (Advanced) — Geometrical Drawing (1 hour). Machine Construction (2 hours). Applied Mechanics (1 hour). Steam and the Steam Engine (2 hours).

NOTES.

(1) Pupils who desire Drawing, Manual Instruction, or Technical Subjects, may select *one* of these groups, but he cannot take any part of any other group of subjects.

SCIENNES

SCIENNES SCHOOL.

Time-table.

Division I.—(Elementary).

Preparatory Classes for the completion of General Elementary Education.

	8 to 9.	9 to 10.
Monday	Arithmetic.	Reading and Spelling.
Tuesday	Arithmetic.	Writing and Composition.

	8 to 8·30.	8·30 to 9·15.	9·15 to 10.
Thursday	Mental Arithmetic *or* Spelling.	Geography *or* Drawing.	Physical Exercises.

Division II.—(Specialised).

For Pupils—(*a*) Who have obtained a Merit Certificate.
or (*b*) Who are over 15 years of age.
or (*c*) Who have obtained a Certificate of satisfactory conduct and diligence in Division I in a previous session.

Commercial Course.

	8 to 9.	9 to 10.
Monday	Book-keeping (Junior). Shorthand (Senior). English. Drawing (Art).	Shorthand (Junior). Book keeping (Senior). Commercial Geography. Drawing (Art).
Tuesday	Shorthand (Junior) Commercial Arithmetic (A). Commercial Arithmetic (C). Physical Exercises.	Shorthand (Senior). Commercial Arithmetic (B). History. Physical Exercises.
Thursday	Book-keeping (Junior). Shorthand (Senior). English. Drawing (Art).	Book-keeping (Senior). Shorthand (Junior). Commercial Arithmetic (C). Drawing (Art).

Technical Course.

	8 to 9.	9 to 10.
Monday and Thursday	Building Construction (Junior). Technical Arithmetic. Drawing (Art). English.	Building Construction (Senior). Technical Arithmetic. Drawing (Art).
Tuesday	Geometrical Drawing (*a*). Drawing. Physical Exercises.	Geometrical Drawing (*b*). Drawing. Physical Exercises.

Notes.

Pupils in Division II must confine themselves to the subjects of one Course—Commercial or Technical.

Shorthand.—A class for speed practice will be formed, should there be a sufficient number of pupils.

Drawing (Art).—Freehand Drawing from the flat, from Casts, and from Common Objects. Drawing in Light and Shade from Casts. Application of Geometrical Drawing to Design.

Physical Exercises will be given to the pupils of both Divisions.

CHAPTER XXVII.

CHAPTER XXVII.

Evening Continuation Schools, America.

[J. W. TURNER.]

Evening Schools, City of New York.—Including the divisions of Manhattan, The Bronx, Queen's, and Richmond, the total enrolment in the Evening Elementary Schools of New York for the year 1900–1901 was 32,482 boys and 17,242 girls—total, 49,724; the enrolment for the same year in the Evening High Schools was 12.578; the enrolment of adults (English speaking) was 7,368; and the number of foreigners learning English was 21,345. The average attendance was very low, only one school showing over 50 per cent. The City Superintendent, commenting upon this section of school work, says:—"Much to my regret I am unable to record any improvement in the regularity of attendance at evening schools. The most satisfactory parts of the work were the teachings in the Evening High Schools and the instruction given to foreigners in speaking and writing the English language. The Evening School term lasts twenty-four weeks in high schools and eighteen weeks in elementary schools."

Evening Schools, Boston.—The term lasts from September to March, and the Evening Elementary and High Schools are open five evenings in the week, two hours each evening. No child under the age of 14 years is admitted to the Evening Schools. The term of the Evening Schools for Industrial Drawing begins in October, and continues for sixty-six working nights. The schools are open three nights in the week, two hours each night. No person is admitted under the age of 15 years. Adult evening classes, intended specially for the poorer people, are held in the Hancock School, Parmenter-street. The list of subjects embraces cookery, dressmaking, embroidery, millinery, basketry, book-keeping, French, singing.

Evening Schools, Springfield, Massachusetts.—The classes in the Evening High School, Springfield, are well organised in one of the finest of modern school buildings. The courses cover commercial and industrial work. Co-education is general in the school, which numbers 300 pupils, and education is free.

The syllabus of work in the Evening School of Trades, Springfield, which is held in the building of the Mechanic Arts High School, is as follows:—

CLASSES IN MECHANICAL DRAWING.

The object of these classes is to teach mechanics and others—either men or women—the principles of mechanical drawing as used by designers, decorators, architects, machinists, and engineers. Each member of these classes should purchase for his own use the following tools and supplies. The outfit costs from $4 to $10, according to the quality of instruments purchased.

1 set drawing instruments.	1 6H Faber or Dixon pencil.
1 12" scale.	1 3H Faber or Dixon pencil.
1 24" T square.	1 Union eraser.
1 30°/60° triangle, 8".	1 folio for drawings, 11" x 15.
1 45° triangle, 6".	2 dozen sheets of drawing paper.
6 thumb-tacks.	1 bottle Higgins' W.P. black drawing ink.
1 curve ruler.	1 bottle Higgins' W.P. carmine drawing ink.

THE COURSE OF INSTRUCTION.

Elementary Class, Two Evenings each Week.

Class instruction in the use of tools and the drawing of plane figures: orthographic projection of lines, surfaces, and solids; the principles of projection applied to the making of working drawings.

Middle Class, Two Evenings each Week.

Class instruction in the development of the surfaces of solids; isometric projection; screw-threads, bolts, nuts, and wrenches; working drawings of simple machines and architectural details.

Advanced Class, Two Evenings each Week.

Individual instruction in the laying out of mechanical motions; the theory and practice in drawing the gear-tooth; epicycloidal and involute forms as applied to the spur and bevel gears; practice in tracing and instruction in blue printing; examples in machine design; the making of practical working drawings from models and figured sketches of architectural and machine details.

The classes are free to all persons over 14 years of age and residents of Springfield. Non-residents are charged $10 for the term. The classes continue for twenty-one weeks, closing on the evening of Thanksgiving Day, and for the usual vacation of the holiday season. School-hours are from 7·15 to 9·15 o'clock. All members are required to be regular in attendance, to complete all drawings and hand them to the instructor, who retains them until the close of the term. Certificates of work accomplished are given at the close of the term.

CLASSES IN MACHINE-SHOP PRACTICE AND TOOL-MAKING.

The object of these classes is to offer to properly-qualified young men an opportunity to obtain training in machine-shop practice and tool-making. The course of instruction is so planned as to give a working knowledge of the various machines, measuring instruments, and methods used by skilled workmen.

The equipment of the machine shop embraces the following machines:—15 engine lathes; 16 speed lathes; 1 Brown and Sharpe universal milling machine, complete with all attachments; 1 Van Norman milling machine; 2 Norton universal grinding-machines; 1 Slate sensitive drill; 1 Prentice upright drill; 2 shapers; 1 Powell planer; 1 water tool-grinder; 1 twist drill-grinder; large assortment of tools for special work.

A modern gas-hardening furnace has been recently added to the equipment. General instruction in hardening will be given to all members of the class, and special instruction to those desiring it.

The course requires some previous knowledge of machine work and mechanical drawing. Applicants are therefore required to furnish satisfactory evidence of ability to undertake the work laid out for these classes. Each member of the class requires for his work the following tools :—

1 6″ scale.
1 3″ outside spring calipers.
1 3″ inside spring calipers.
1 3″ dividers.
1 centre or thread-tool gauge.

It will be insisted upon that each member of each class provide himself with the above-mentioned tools, and it is desirable that he should have his own micrometer and a 3″ square.

The Course of Instruction.

Beginners' Class—Two Evenings each Week.

There are three classes—the beginners' class, the intermediate class, and the class in advanced tool-making.

The members of the beginners' class are given thorough instruction in the use of machine and hand-tools. The course embraces the following exercises :—

1. Filing.
2. Hand-turning on speed-lathe.
3. Special exercises in turning (straight and taper) and boring on speed-lathe.
4. Exercises in fastening work to face-plate of lathe, and locating working points by means of the lathe indicator.
5. Elementary exercises in lathe, planer, and shaper work.

The Intermediate Class—Two Evenings each Week.

The intermediate class is composed of men who have received the instruction mentioned in the Beginners' Course. The exercises given are of a more advanced nature, and bring into use the machines mentioned :—

1. Straight and Spiral Milling Cutters—
   Lathe (chucking and turning), milling machine and grinder, and instruction in hardening and tempering.
2. Shank Mills—
   Lathe, milling machine, and grinder.
3. Counterbores—
   Lathe, milling machine, and grinder.
4. Nut Arbours—
   Lathe.
5. V Blocks—
   Planer or shaper.
6. Special forms of Milling Machine Cutters—
   Lathe, milling machine, and grinder.
7. Special exercise in Filing.

The Advanced Class—Two Evenings each Week.

The course for the class in advanced tool-making is so arranged as to give very thorough instruction in laying out work and working to accurate measurements. The exercises are of a character indicated by the following :—

1. Internal Cylindrical Gauges.
2. External Cylindrical Gauges.
3. Taps and Dies.
4. Punches and Dies.
5. Drill Jigs.
6. Instruction in special milling-machine cutter work, and other work involving exercises of special value.

Special instruction is given in the various processes used in hardening and tempering steel. Practical talks on modern machine-shop methods are given occasionally by men of experience who are authorities on such subjects.

The classes meet two evenings each week for twenty-one weeks, closing on the evening of Thanksgiving Day, and for the usual vacation of the holiday season. School-hours are from 7·15 to 10 15. All members are required to be regular in attendance. Persons wishing to join the classes must give satisfactory references as to character and ability.

Tuition is free to all residents of Springfield. Non-residents will be charged a fee of $15·00 per term for instruction. A fee of $5·00 for incidentals is charged all members of these classes, whether resident or non-resident.

A certificate of work accomplished is given each member of the class at the close of the term.

CLASSES IN PLUMBING.

The Course of Instruction.

Water Supply.

Beginners' Class—Theoretical Instruction.

1. Alloys and metals. Solder and its manipulation.
2. Hydraulic rams—how to set and operate. Charts.
3. Pumps—how to install and repair. Charts.
4. Water. Service pipes, friction, etc.
5. Water supply. Air locks ; water hammer, cause and remedy.
6. Water regulators. Practical gauge tests. Chart.
7. Water-meters—how to read. Samples. Chart.
8. Filters. Samples.
9. Boilers. Circulation of water ; faulty and correct method. Charts.
10. Tanks ; faucets ; ball-cocks ; valves, safety and vacuum. Charts.

Beginners' Class—Practical Instruction.

Methods of joining metals. Tools ; names and use.
Preparing pipe ends. Straightening pipe.
Tacks—making and putting on. Cleaning and testing solder.
Cup joints ; overcast joints.
Wiped joints—round, upright, and underhand.
Wiped joints—branch, underhand, upright, side.
,, ,, branch, 3-way, 4-way.
,, ,, faucets and stop-cocks.
Packing bibbs and ball-cocks.
Setting up and connecting boiler with range and tank.
Tank lining and general water supply.

Drainage Work.

Advanced Class—Theoretical Instruction.

1. Hygiene. Ventilation.
2. Drainage systems. Cesspools—construction and location. Sewer, drain, and soil pipe.
3. Subsoil drainage. Cellar drainers. Demonstration.
4. House drainage. Ventilation. Plenum and vacuum. Fresh air inlets. Frozen vent-pipes.
   Foul-drain air—where it should be discharged.
5. The syphon, and its action in house plumbing.
6. Traps. Grease pattern. Where to vent a pipe.
7. Trap tests. Various patterns demonstrated.
8. Fixtures. Baths, sinks, urinals, lavatories, laundry tubs.
9. Water-closets. Care of plumbing fixtures.
10. Summary. Arrangement of plumbing fixtures.

Advanced

Advanced Class—Practical Instruction.

Making joints on waste and drainage work.
,, ,, $1\frac{1}{4}$ in. T branch, Y branch.
,, ,, 2 in. ferrule, 4 in. ferrule.
,, ,, flanges, side and upright.
,, ,, electric conduit.

Making bends, offsets, sand and spring.
,, soil-pipe joints, upright and underhand
Setting up soil-pipe for various systems of venting.
,, plumbing fixtures.

Each member of the class must furnish necessary tools and material used in practice work. List of tools needed :—

Grease-box.	Plumber's hammer.	Caulking tools—3.
Ladle.	Screw-driver.	Compass saw.
File.	Swivel copper.	Tap borer.
Wiping cloths—3.	Compasses—6 in.	Bending pin.
Solder-pot—5 in.	Cold chisel—6 in.	Rule—2 foot.
Turn-pin.	Rasp.	Shave-hook.

Certificates of proficiency are awarded to those who complete the full course satisfactorily.

Tuition is free to residents of the city, but a fee of \$5·00 is charged for incidentals. Non-residents are charged \$20·00 for the term of twenty-one weeks. This includes the fee of \$5·00 for incidentals.

CLASSES IN WOOD-TURNING AND PATTERN-MAKING.

Practical instruction is given in wood-turning and machine pattern-making.

The work consists in the making and finishing of solid and built-up patterns for general machine parts, such as bushings, journal boxes, pillow blocks, hangers, pulleys, brackets, gears, valves, cylinders, etc., and the necessary core-boxes.

The equipment of the wood-working shop consists of the following: One Colburn universal saw-bench, with two adjustable saws and tilting-table; one S. A. Wood's band saw (36 in.); one 24 pattern-makers' lathe; one universal wood-trimmer; twenty 10 in. wood-turning lathes; and a full complement of hand tools.

The course of instruction is arranged to meet the requirements, both of the beginner and of the experienced workman, the character of the work depending upon the previous training.

The classes meet three evenings each week for twenty-one weeks, closing on the evening of Thanksgiving Day and for the usual vacation of the holiday season. School-hours are from 7·15 to 9·15. All members are required to be regular in attendance. Persons wishing to join the classes must give satisfactory references as to character and ability. The total membership for these classes is limited to twenty.

Tuition is free to all residents of Springfield. Non-residents are charged a fee of \$15·00 per year for instruction. A fee of \$5·00 for incidentals is charged all members of this class, whether resident or non-resident.

A certificate of work accomplished is given each member of the class at the close of the term.

CLASSES IN MATHEMATICS.

The courses of instruction in Mathematics are arranged with special regard to the needs of mechanics, and include such topics of Arithmetic, Algebra, Geometry, and Trigonometry as find direct application in the mechanical trades. Mathematical text-books are used to some extent, but they are not followed closely. The constant aim is to make the instruction distinctly practical. The work is closely correlated with the shop practice and drawing, and all members of the classes are encouraged to bring in problems suggested by their own experience. While the method of construction is designed to secure the benefits of class-work, much individual help is given.

Tuition and text-books are free to residents of Springfield Non-residents are charged a fee of \$10·00 for the course. Certificates of proficiency are awarded in each course to those who complete it satisfactorily.

CLASSES IN ELECTRICITY.

The courses in Electricity are under the immediate direction of the Principal of the school, and are thoroughly practical. They are designed for a twofold purpose: first, to meet the needs of those whose occupations require a practical knowledge of electrical principles and their application, but do not intend to make a business of electrical work; second, to offer practical instruction in electrical measurements and electrical construction to properly-qualified persons who are employed wholly or in part in this work, or who desire to fit themselves for it. It is the aim of the lecture course to meet the first purpose, and the laboratory course is designed for the second.

The Course of Lectures.

1. Fundamental facts and principles of magnetism.
2. Fundamental facts and principles of electricity.
3. Voltaic electricity and primary batteries.
4. Effects of the electric current upon conductors.
5. Measurement of current strength.
6. Resistance of electrical conductors, the laws of electrical resistance, and methods of measurement.
7. Electromotive force and Ohm's law.
8. Electromagnetic induction and its applications.
9. Fundamental principles of the dynamo and motor.
10. The telephone.
11. Some details of construction of dynamo electric machines and motors.
12. Suggestions upon the management of dynamo electric machines and motors.

Besides the more practical lectures, a number of popular lectures are given on such subjects as High Potential Discharges in Vaccuum Tubes, the Roentgen or X Rays, and Wireless Telegraphy.

The Laboratory Course.

1. Setting up and connecting primary batteries.
2. Connecting electrical bell circuits.
3. Wiring for electric gas lighting.
4. Wiring for incandescent lighting, including both the two-wire and three-wire systems.
5. Measurement of electrical resistance by substitution and by direct reading instruments.
6. Winding of dynamo and motor armatures and fields.
7. Electric station and switch-board practice.

Tuition is free to residents of Springfield, but in the laboratory course a charge of \$5·00 is made to cover the cost of materials and breakage. Tuition for non-residents is \$10·00.

CHAPTER XXVIII.

CHAPTER XXVIII.

Technical Education for Girls—Domestic Science, New South Wales.

[J. W. TURNER.]

Introduction.—Although the older countries have long since recognised the value of technical education for girls, we in New South Wales seem only to be awakening to the fact that there is any necessity for the same.

Home is decidedly the woman's sphere, and the more intelligent woman is, the better for the nation at large. We should teach our girls domestic science, impress them with the dignity of housework in all its branches, and inculcate the desire to become intelligent and useful home women. Comparatively few girls of the middle class leave school now to enter a home—factories and shops claim most—and neither place is conducive to their well-being. This state of affairs should not be encouraged; and if every girl in our public schools were required to go through a complete course of domestic science, the percentage of girls who dislike housework would be materially decreased.

What Domestic Science Includes.

Under the heading of Domestic Science come:—

Management of domestic income, teaching the value of money, and how best to spend it.
Chemistry of food.
Art of cookery.
Practical housework.
Laundry work.
Needlework.
Hygiene.
Home nursing.

We, in this State, have only touched the fringe of this great question, needlework and cookery being the only two subjects that have been given a place in the school curriculum under the heading of domestic economy.

I. Needlework in New South Wales Schools.

Needlework is taught in almost all schools under the Department of Public Instruction with most satisfactory results as far as neatness and accuracy go. Much of the work is beautifully done, but there is a tendency to reduce it to a merely mechanical task. It is much easier for a workmistress to set a seam than require a pupil to do the same for herself, but time could be saved, and more beneficial results obtained, if each sewing lesson began with a short theory exercise, aided by blackboard illustrations, and by demonstration. Pupils should be required to note methods adopted for making button-holes, sewing on tapes, setting seams in different garments, noting relative widths of hems, &c., and they should then be expected, as far as possible, to make necessary measurements, and arrange seams for themselves. After once learning the stitches required for darning, and methods for patching in small samplers, it would be advisable for pupils to bring from home garments that really required mending. Such practical work would give variety and room for thought, because very rarely do we find in any one garment two rents that require exactly the same treatment. The introduction of sewing machines into our schools for the exclusive use of elder pupils who have satisfactorily passed the standard of proficiency in plain sewing, would mean an additional saving of time, and ensure thoroughly practical instruction. A long seam, representing two or three hours' work, if done by the hand, could be machined in ten or fifteen minutes, with an equally good result, and the girl who can sew neatly, might, with advantage, be taught to manage a machine.

In addition to sewing, girls are taught to cut out paper patterns of various garments, but it would be advisable, as soon as they grasp the idea of cutting and fitting, to allow them to use material, and cut out and make garments for themselves, thus encouraging them to put to practical use all information gleaned in school.

In this connection it is suggested (1) that theory lessons be given to the class before beginning sewing; (2) that pupils be encouraged to set their own work; (3) that a sewing machine be provided for the exclusive use of elder girls, who should be required to cut out and make their own garments.

"Household Sewing, with Home Dressmaking," by Bertha Banner, School of Domestic Science, Liverpool, will be found a valuable text-book.

II.

II. Cookery in New South Wales Schools.

Upwards of fifteen years ago our first staff of teachers of cookery was trained at the Fort-street School, and six cookery schools were established. The number of schools has varied since but never exceeded nine, which represents the present number. These classes have been conducted in thirty different centres (the portable system being adopted in some instances), and on an average the children attending at each have been drawn from five schools. It may thus be claimed that one hundred and fifty different schools have had the advantage of a cookery class, but when we remember that there are over nineteen hundred public schools in our State, we see how great the need is for extending this useful branch of education. The appointments of cookery schools as at present furnished, permit of twelve pupils being daily instructed in the art of practical cookery by each teacher. The course of instruction extends over twenty-one weeks per half year; thus at each school one hundred and twenty pupils are trained each year. In addition to this a weekly demonstration in domestic economy has been arranged, which is attended by sixty children at six centres, thus enabling seven hundred and twenty children yearly, in addition to those attending practical cookery classes, to get the benefit of instruction in the art of housekeeping. Even with these additional classes the percentage of our public school girls, who are thus benefited, is far too small.

Further Domestic Teaching Necessary in our Schools.

This much the State has accomplished, but the management of domestic income, chemistry of food, choice and storage of food, arrangement of menu, how to set a table, and wait on same, should be taught in connection with the art of cookery.

Then come:—Theory of household management and practical housework, which embody methodical arrangement of work, hints on furnishing, economy of labour and time, house sanitation, drainage, ventilation, cleaning different rooms, walls, floors, &c. Laundry work should be taught in connection with the choice and care of clothing, and dealt with on a scientific basis. Since good materials may be bought, but ruined in the wash, it is most important to impress the value of strict adherence to correct methods and of honest work in this department. A few of these subjects are touched on in the course of lessons in domestic economy before mentioned, but it is necessary that they should all be thoroughly taught. There is urgent need for extending this branch of technical education, but provision must first be made to ensure a large and competent staff of teachers.

Domestic science embraces so many subjects, that it can only be satisfactorily taught by those who have made it a special study.

Present Training of Cookery Teachers, New South Wales.

According to the present system, pupils drawn from cookery schools are trained as teachers of cookery at Fort-street Model School. A yearly competitive examination is held, and scholarships are granted to the four most successful students. The term of training is four years, and embraces the subjects included under the heading of Domestic Science. There are now thirteen students in training, five in third year, four in second year, and four in first year. This number would warrant a permanent supply of teachers for about twelve cookery centres, but that is not sufficient for the need of the State.

System of Training in School of Cookery, Buckingham Palace Road.

The training system in vogue at the National Training School of Cookery in Buckingham Palace Road, Westminster, is one that might well be introduced here. Applicants for the position of teachers of domestic science must *be at least eighteen years of age* before they are admitted to the training school, and must pass an entrance examination to show that they are sufficiently educated to act as instructresses after they have trained in whatever subject they wish to teach. No diploma is awarded unless students pass theoretical and practical tests, in class teaching, art of demonstrating to both school children and adults, and in general school management. Students must train for not less than forty weeks to qualify for a Cookery Teacher's Diploma—Fee £35; for Housewifery, thirteen weeks' training (320 hours),—Fee, £8 8s.; dressmaking, needlework, and millinery courses for teacher's diploma, minimum time of training, eighteen weeks for each subject. For the average student that length of time is sufficient, but for slow-workers longer time is necessary and training is continued at 10s. 6d. per week.

Fees are—

Dressmaking and needlework,	100	lessons of 4 hours	... ...	12 guineas.
Plain dressmaking,	100	,, ,,	.. ..	7 ,,
Plain needlework,	100	,, ,,	... ...	7 ,,
Advanced dressmaking,	110	,, ,,	... ...	7 ,,
Advanced needlework,	100	,, ,,	... ...	7 ,,
Eight weeks course of millinery,	40	,, ,,	... ...	7 ,,

Laundry teachers' diploma requires students to have trained twenty-six weeks—Fee 10 guineas.

In connection with this training school the Committee do not guarantee to find any appointments for students when trained.

The Primus Stove.

In New Zealand, cookery is taught at a nominal cost in many country schools by means of Primus stoves. The Primus stove is well known and largely used throughout this State so that this system could be introduced with advantage into our schools.

Students in training at Hurlstone College are required to take a course of Domestic Economy lessons, and attend both demonstration and practical cookery classes.

These students are sent as assissants to schools all over the State, and, if they were armed with a knowledge of the main principles of cookery they could, with the aid of a Primus stove regularly give instructions to the elder girls, and by that means cookery could be taught [illegible] assistant is employed. Of course, such instruction would be of the very simplest, but as the subjoined syllabus shows it would also be most practical.

3—2 O

The

The time spent in the study of Domestic Economy by students in training would not need to be extended, since all required to be taught by them could be learned in the same time as they now spend in the cookery-room. The adoption of this suggestion is strongly recommended as it means a wholesale extension of instruction in Domestic Economy at a minimum cost in a practical way. In New Zealand the visiting teachers of cookery are provided at each cookery centre with three Primus lamps, one stand, one oven and utensils for boiling, steaming, &c., the initial cost of the same being not more than £10, and the working expenses very small indeed.

Need for a Technical High School for Girls in Sydney.

A want much felt by us in the lack of training ground for girls between the ages of 13 or 14 when they leave the primary schools, and 16 and 18 when they are old enough to enter college or the higher technical institutions. This need has been promptly met in many countries by the establishment of technical high schools for girls which provide for a two or four years' course of training, and from which girls enter high schools or colleges and qualify for whatever position they desire to fill.

Examples of Girls' High Schools in the Technical Side.

In the chapter on the Technical High School for Girls, New York, the course of instruction at such a high school is given in full. In such schools as the Shropshire Technical School for Girls, and the Residental School for Household and Domestic training recognised by the Education Department in Sussex, girls are taught the dignity of all household tasks, and according to circumstances are trained to take their place as helps in the home or to earn their own living, in which case they carry certificates from these institutions as credentials. The Hague Industrial School for Girls, established twenty-six years ago, with a view to the promotion of education of girls, provides for a course of five years' instruction to girls over 13 years of age. The syllabus which aims at turning out practical women is a very comprehensive one. It includes millinery, dressmaking, knitting, darning, embroidery, arithmetic, book-keeping, drawing, and all ordinary subjects. (*Vide* Chapter—Industrial Training in Europe.)

In practical housework, as taught here, a very special feature is the work done among carpets. Unsightly pieces of old, but once valuable, carpets are mended and cleaned, and made to look almost equal to new. In all these schools evening classes are held, which specially benefit those of the working-class whose technical education had been neglected in earlier years. In the English schools mistresses willingly pay the required fee for courses of practical instruction to maids in cookery, housewifery, or laundry work.

Distributing Kitchens.

In many cases "distributing kitchens" are attached to colleges of cookery; and, by giving twenty-four hours' notice, a family, or families, may be served in their homes with a full-course meal at stated cost. People who have travelled much invariably remark upon the want of such an institution in our States, and it is certain that such would be a valuable adjunct to a girls' technical school, as it would be a means of sure return for money spent in provision for cookery practice.

Need of a Training-school in Sydney for Teachers of Domestic Science.

The Commissioner would strongly recommend the establishment of a technical school for girls, combined with a training school for teachers of domestic science. In order to give full scope for such training, and to ensure a speedy return for extensive outlay, he would further suggest that the site chosen be in Sydney, and that "residential chambers" and "distributing kitchen" be connected with same. This scheme of uniting a training-school with the reception of lady boarders and lodgers has been tried with success both in Hanover and in the Isle of Wight. The ground floor of the building must contain kitchen, laundry, demonstrating theatre, and lecture-room, chemical laboratory, and public dining hall. The upper stories could be let in flats or single apartments; and if people of means could be induced to occupy same, and furnish for themselves, the care of their valuable furniture and ornaments would constitute admirable training in housework. Most training-schools fail because they have nothing but bare rooms in which to teach the niceties of housework, so that girls have no practice in keeping in order a well-appointed house. In order to permit of meals being served in boarders' own rooms, a lift would be necessary.

Although the initial expense in establishing such a school would necessarily be great, worked on plans suggested it could be made almost, if not wholly, self-supporting. As is the case of colleges of this kind in other countries, fees in accordance with instruction given would be charged. Accommodation for house staff and students would be provided, fees charged, including board (when necessary), lodging, or instruction. In Southdown House, Sussex, 25s. per week is charged, the same fee at Buckingham Palace Road, and £13 6s. 8d. per quarter at Shropshire Technical School. Public school classes are exempt from fees. *Scholarships* can be obtained from the school, and holders of the same are enabled to get advanced instruction at reduced fees.

Our own System Practical, Economical, but not Far-reaching.

The combined course of twenty-one practical lessons in primary and plain cookery now in use in our schools could not well be improved on, since dishes chosen embrace examples of all different methods of cooking, with most economical and satisfactory results. The domestic economy course of twenty lessons taught at the same time is also a comprehensive and practical one; but comparing this branch of instruction as taught in our schools with the system in other countries, it is found that more is taught in a shorter time, that is, a course that we teach in six months is spread over two years in some places. School children here spend one whole day a week in the cookery schools. In various centres of America we find two or three classes a day receive instruction in cookery, in which case the pupils cook very little at each lesson, but what they cook they are allowed to claim. In our State the cookery schools may be made largely self-supporting. The practical cookery is done in the morning, and the results supply many with a substantial midday meal, at the trifling cost of 6d. or 9d. The disadvantage of our system is the fact that too few school pupils are benefited by it.

Suggestion

Suggestion to increase Attendance at our Cookery Schools.

Until more cookery schools are established, the Commissioner would recommend that two classes be taken daily instead of one, so that the number of children reached would be double. The amount of instruction received by each would necessarily be less than that taught now, but sufficient could be taught to give the girls an intelligent insight into methods of plain cookery. To economise in provision material, dinner dishes could be cooked in the morning class, and tea and lunch dishes taught in afternoon class; and to give all pupils an equal chance the afternoon class of one week would be the morning class the week following.

Existing Cookery Classes for Public School Pupils, New South Wales.

Now taught, twelve pupils; same girls one day each week.

Lesson 1. Practical cleaning.
" 2. Roasting and baking meat, Yorkshire pudding, clarified fat and caramel.
" 3. { Grilling—Chop and stake.
Boiling—Mutton, cornbeef.
" 4. Vegetables—Potatoes, cabbage, peas, beans, cauliflower.
" 5. Stewing—Tripe and onions, Irish stew, stewed steak, stewed ox tail.
" 6. Puddings—Urney pudding, currant, rice, boiled fruit, steak and kidney pudding.
" 7. Pastry—Meat pies, fruit pies, turnovers, jam tarts, Cornish pasties.
" 8. Soups—Stock, vegetable soup, pea soup, cottage broth.
" 9. Tea, coffee, porridge, toast, eggs, poached eggs, eggs and bacon, steak and onions.
" 10. Cakes—plain, sponge, currant cakes, scones, milk loaves.
" 11. Fish—boiled, baked, fried, and stewed.
" 12. Mutton broth, beef-tea, gruel, arrowroot, rice-water, toast and water.
" 13. Liver and bacon, pancakes, cutlets (piquante sauce), fritters.
" 14. Blanc-mange, custard, apple dumplings, stewed fruit.
" 15. Soups—tomato, onion, ox tail.
" 16. Gingerbread, seed cake, jam roll, buns, Yorkshire tea cakes.
" 17. Boiled fowl, egg sauce; roast fowl, bread or celery sauce; grilled chicken.
" 18. Pudding—date, lemon, bread and butter, plum.
" 19. Braised steak, rissoles, brawn.
" 20. Salads—mixed, potato, tomato, chicken, fruit.
" 21. Bottled fruit, tomato sauce, pickles.

Domestic Economy (New South Wales).

Course of Twenty Lessons.

Now taught; classes of sixty pupils, one hour per week.

1. Cleaning.—Specially noting methods for cleaning stoves and all cookery utensils, scrubbing, washing dishes, care of tea-towels, dishcloths, and sinks.
2. Lighting Fires.—Management of gas and wood and coal stoves. Demonstrate. Making and baking scones. Teach equivalents of weights by measuring with spoons, cups, &c.
3. Demonstrate preparation of a simple dinner.—Grilled chops, boiled potatoes, rice pudding. Demonstrate the effects of dry and moist heat on meat, and teach reasons for methods adopted.
4. Soup-making.—Teach principles, and demonstrate the making of stock.
5. Marketing.—Note rules to guide one in choice of vegetables. Teach seasons for same; also food-value. Demonstrate how to prepare, cook, and serve any one green vegetable in season.
6. Marketing (*continued*).—Rules to guide in choice of meat, fish, milk, groceries. Teach, by use of diagram, the different cuts of meat, and their comparative prices and value.
7. Principles of Roasting and Baking.—Demonstrate the preparation of a joint, and teach how to make gravy and caramel.
8. Management of Domestic Income, Household Stores, and Arrangement of Meals, with a view to economy.
9. Principles of Boiling and Stewing.—Demonstrate haricot or stewed steak.
10. Preparation of simple Breakfast.—Plate of porridge, poached egg, cup of tea or coffee. Teach work of house that should be done at the same time.
11. Pastry-making.—Demonstrate short crust and suet crust. Teach food value.
12. Simple Dinner.—Liver and bacon, mashed potatoes, bread and butter pudding. Teach principles of frying.
13. Arrangement of a week's Housework, with useful information as to the necessity of regular and methodical cleaning. If possible, demonstrate bedmaking; but, if not able to demonstrate thoroughly, teach correct method, and ask girls to try same at home.
14. Invalid Cookery and Home Nursing.—Give rules for invalid cookery, and teach necessity for extreme care in preparation of food. Teach how to make and serve beef-tea, barley water, gruel, toast-water, and arrowroot.
15. Home Nursing (*continued*).—Teach simple rules for care of invalid, how to make a simple poultice, apply a hot fomentation, and how to treat a burn or scald; what to do in case of faintness, &c.
16. Pastry-making: Flaky.—Demonstrate steak-pie.
17. Simple Dinner.—Cottage broth, Irish stew, green vegetables.
18. Sanitary Dress.—Simple rules to guide in choice of material and style.
19. Dress (*continued*).—Note errors to be avoided, and advise as to health considerations.
20. How to arrange a Menu.—Set a table, and wait at same.

Training of Students of Cookery.

Syllabus in present use in New South Wales.

1st Year.—Special attention to plain cookery. Elements of physiology. Sources and varieties of food. Art of demonstrating and management of class.

2nd Year.—Continuation of 1st year. High-class cookery. Test lessons.

3rd Year.—Domestic economy, home nursing, hygiene, with regular charge of plain cookery practice and demonstration classes.

4th Year.—Continuation of 3rd year, with additional responsibilities, book-keeping, housekeeping, management of official returns, and giving services as relieving assistants at various cookery schools.

Syllabus of Knowledge which should be required of Students trained as Teachers of Domestic Science in New South Wales.

Practical knowledge of scullery work. Practical knowledge of the principles of cookery—primary, plain, and high-class. Theory and practice of education, chemistry of food and cookery.

(*a*) Psychological value of domestic education. How best to train the senses, memory, will, judgment, and reasoning powers by means of domestic subjects.

(*b*) Drawing up notes of lessons for pupils of various ages. How to use illustrations and blackboard.

(*c*) School management, including keeping registers, &c.

(*d*) Chemistry of food and its relation to cookery.

Practical housework and home management. Theory of household management. Sick nursing. Simple remedies, &c. How to render "first aid" to injured. Elementary laundry work. Theoretical and practical. Treating of materials from which clothing is made. Washing fabrics, and methods of treating same. Starching, ironing, &c.

Text Books: "Story's Economic Cookery Book." "Mary Harrison's Guide to Practical Cookery." "The New Century Cookery Book." By H. Senn. "Paul's Domestic Economy." "Elementary Laundry Work." F. C. Calder and E. Mann. "Manual of Housewifery." Helena Head.

Course of Instruction possible with aid of Primus Stove.

Time, one hour per week—Demonstration only—three hours per week if girls be given practice.

I. Boiling and Steaming. Teach principles. Demonstrate how to boil and serve a neck of mutton.
II. Baking and Roasting. Teach principles. Demonstrate how to bake a loin of mutton.
III. Stewing. Teach principles. Demonstrate haricot and Irish stew.
IV. Soup-making. Teach principles. Demonstrate stock-making and broth.
V. Vegetables. Demonstrate cooking and serving root and green vegetables.
VI. Hints on Care of Sick, how to prepare and serve food for same. Demonstrate beef-tea, gruel, arrowroot, barley-water.
VII. Pudding-making. Boiled meat pudding, steamed sweet pudding, baked milk pudding.
VIII. Cake-making. Scones, milk rolls, sponge, gingerbread.
IX. Management of Breakfast. Tea, coffee, toast, porridge, &c.
X. Principles of Frying. Demonstrate cutlets and fritters.
XI. Poultry or Fish (choice to be made according to supplies obtainable in district). Teach how to truss and bake or boil a fowl, or fillet and fry fish, bake or boil fish.

Where demonstrations only are given, the cost of material would be little, if any, since most parents would gladly supply ingredients and make use of dishes when cooked.

Text Book:—"Story's Economic Cookery Book."

A Suggested Course of Study on Domestic Science suitable for Students in Technical High School. Two Years.

1st Year.

All ordinary subjects to be studied at same time.
Three hours per week, *i.e.*, 120 hours yearly, to be devoted to study of domestic science.
Sixty hours spent in kitchen in practical cookery and practical cleaning.
Twenty hours in Demonstrating-room.
Twenty hours in study of chemistry of food.

Lessons suggested for remaining twenty hours:—

Home Nursing ...
1. Personal hygiene.
2. Home nursing—management of sick room.
3. Simple rules to be observed in common ailments.
4. First aid in cases of accident and sudden illness.
5. How to make and apply poultices, ice-bags, and fomentations.

Housewifery ...
6. Methods of housework—ordinary day's work.
7. How to sweep and dust a bedroom and make a bed.
8. Management of floor-coverings.
9. How to polish furniture and remove stains.
10. Spring cleaning of a bedroom and sitting room.
11. Expenditure of income.
12. Hints on buying and storing foods.
13. Household economies.
14. Arrangement of menus.
15. Method of setting a table and waiting on same.

Sewing ... ...
16. Plain sewing, running, stitching, backstitching, hemming—revision of these stitches, teaching proper methods.
17. Darning.
18. Patching.
19. Plain knitting.
20. Cutting out undergarments.

2nd

2nd Year.

Continuation of 1st year, devoting less time to housewifery and more to sewing.

Sixty hours. Advanced cookery, icing, preserving, and jam-making included.
Twenty hours. Demonstrations, including a course of cookery specially for invalids.
Twenty hours. Chemistry of food, practical experiments, and study of different methods of preserving foods.

For remaining twenty hours:—

Hygiene ...
1. Ventilation.
2. House sanitation (drainage).
3. Disposal of waste matters (sewage).
4. Conditions of germ life.
5. Prevention of infectious diseases.
6. Management of triangular and roller bandages
7. Choice of dress materials (rules to guide).
8. Sanitary dress.
9. Beverages.
10. Work and rest.

Sewing ...
11. Ornamental and plain stitches.
12. Cutting out and making simple garments.
13. Methods of fitting plain bodice and sleeves.
14. Making plain blouse.
15. Correct way of finishing off seams, &c., in dress.
16. Darning and refooting stockings and socks.
17. Refooting a knitted sock.
18. Marking linen—fancy stitches.

Laundry ...
19. Simple rules to guide in correct methods of washing materials
20. Starching and ironing—hints *re* same.

CHAPTER XXIX.

CHAPTER XXIX.

General View of Higher Technological and Professional Education.

[G. H. KNIBBS.]

1. *Introduction.*—The great development of technical education, characteristic of the last half century, has given rise to questions of organisation, such as have brought certain issues into a clearer light, viz., those which concern its various grades, and the necessary preparation for entering upon them.

It has been shewn in the Commissioners' Reports on Primary and Secondary Education, that there is a marked distinction between higher primary and secondary education. The latter is not a *continuation* of the former, it is education of another type. The differences in technical education are analogous. For the artizan, and for the lower branches of commercial service, for the working farmer, etc., the normal preparation is to be had in the elementary school. But, as soon as it comes to a question of superintendence of industry, and still more when the wise direction of its highest planes is under consideration, higher demands have to be met in regard to the scheme of preparatory education; and hence some acquaintance with secondary education, or at any rate with higher primary education, is essential. For the highest grades of technical education a very thorough "secondary" preparation is demanded, and the final course must be of the University type.

2. *Technical and Professional Training.*—Although technical processes are essentially practical, their success under modern conditions depends upon liberal knowledge, particularly upon ability to command the resources which modern science has placed at the disposal of Man. In reality a kind of double qualification is demanded. The technologist must necessarily be appreciative in regard to scientific research, which of course is not utilitarian in its aim. Pure science does not yield a knowledge of Nature in the form needed in technical processes, and technical experts are but rarely discoverers of scientific truths, for the genius of discovery and that of application are characteristically different. Yet the master of technical processes must have a lively sympathy with the achievements of those who discover the secrets of Nature, and he must possess in addition the capacity to see how these can be turned to account from the standpoint of utility. Hence the proper training of a technologist exercises not only the faculty of acquiring knowledge already discovered but also the faculty of turning it to practical account, *i.e.*, "applying" it; while the pure scientist must acquire the faculty of discovering the unknown. In both, the power of initiative is a *sine qua non.*

Educational experience has shewn that there must be very direct touch with scientific method, if technologists are to be well equipped. Hence the atmosphere of the University is necessary, and, in order to derive adequate benefit, the technologist must take some part in the methods of scientific work, and even in research.

Facts of this kind have thrown new light upon the character of all higher occupation of mankind. It is more clearly recognised that the old division of the professions is not based upon any real distinction in fact. All the higher walks of life have what may be called their trade aspects—the routine and business element—which cannot properly command other recognition than that they are necessary. And, on the other hand, every higher walk has its liberal element; that which keeps the mind in touch with something besides utility, which, while engaged in what is directly of service, does so in a way which lends it dignity.

The training in technology, and in the professional walks of life—which are now regarded as including scientific agriculture, architecture, various forms of engineering, geodetical activity, the occupations of the scientific chemist, metallurgist, and so on requires that impress on the practitioner's mental habit which is naturally and readily acquired, not in the so-called practical workshop, but in the laboratory of investigation and research.

Modern developments of technical and industrial processes have made it imperative that the control should be liberal, not merely utilitarian; that the processes should be regarded from the rational, not from the empirical standpoint; and modern industrial and commercial competition accentuates this demand.

3. *Replacement of Empirical by Rational Methods.*—The characteristic of the increase of knowledge is that facts, empirically understood, are being brought under an organised system, that is to say, they are made to form part of a rational theory of the group to which they belong. In the past, many technical processes were followed, simply because they were known to give good results; the underlying reason, however, being completely hidden. All modern effort is an attempt to reduce every technical process to the rational form. One or two illustrations may serve to bring into relief what is meant by this statement. Some years ago English brewing methods yielded better results than continental; both were absolutely empirical. Continental brewers, therefore, learnt the English art, also empirically; but, on returning home, invoked the aid of chemists and bacteriologists, in order to discover what was the secret of the differences in the results obtained when different processes were followed. The result was that the processes were intelligently controlled by continental Europeans earlier than by ourselves. That this dictum is justified is shewn by the fact that one of the most modern features of English laboratories is the possession of a small brewing plant, with annexed chemical and bacteriological laboratories, for the investigation of processes of fermentation, etc., a feature which forcefully expresses our recognition of the practical value of the European method.

The

The strides that have been made in the use of pure cultures of ferment organisms is well known to experts in the technology of fermentation, and incidentally it may be mentioned that the Colonial Sugar Company find the use of pure cultures to result in very distinct advantage.

The consequence of the replacement of empirical by rational knowledge is sometimes very far-reaching. The synthesis of the dye indigo is a question involving what might appear to the uninitiated as *uninteresting* and tedious discussion on the mode of combination of atoms in the molecule. Practically it means this, viz., that at the present time it is not possible for the natural to compete with the synthetic product, the latter being produced not only more economically, but in a more advantageous physical form. Its quality, moreover, is equal to that of the highest grade of the natural product. The direct consequence of this is that the indigo-growing industry in India is decaying at a serious rate, while the manufacture of the synthetic dye is progressing by leaps and bounds. This transfers the trade advantage from England to Germany.

Whether it be possible to alter such a fact by attention to the culture of the indigo plants is a matter which has yet to be established. Experience with beet-root shews that the case is not necessarily absolutely hopeless.

The production of sugar from beet not only forms an illustration of how far-reaching technical knowledge is ; it also shews that national economy will in the future not have to be guided solely by the experience of the past, but will have also to take into account the service which scientific and technical knowledge may render. Beet-sugar industry could hardly have risen to its present position without substantial assistance. Initially the lower yield of sugar made it impossible to compete with the tropical product, viz., cane-sugar. Several elements were necessary to change all this. Agriculturists were shewing that culture and the use of fertilisers were followed with conspicuous advantage, that the increased labour involved was repaid many times over in the yield. Scientific horticulture was proving that the characteristics of plant life may be modified through very wide limits. This was turned to account in the case of the beet by developing a variety capable of giving a larger sugar yield, and by ascertaining also the cultural conditions under which that yield might attain a maximum.

The process of extraction was also to be improved ; the earlier methods failed to exhaust the opportunity of getting all the sugar possible, and hence the technique of extraction demanded the services of the chemical technologist.

The whole result of a systematic attack on the problem was that, within about a decade, the yield was enormously increased, viz. about $2\frac{1}{3}$ times; and it is at present impossible for cane-sugar to compete on equal terms.

Another and far-reaching illustration may be taken. Recent metallurgical research has not only vastly increased our power of dealing successfully with what are known as refractory ores, and in many cases greatly cheapened the processes of reduction, it has also disclosed a large amount of knowledge as to the effect on physical property of the addition of small or large amounts of other substances. Thus in the iron and steel industry a variety of qualities can be imparted by the addition or diminution—as the case may be—of various other metals or non-metals.

But, again, the improvements in physical property involved a very wide field of human knowledge,—chemistry, spectroscopy, and microscopy had to be invoked. There is, for example, already quite a large literature on the microscopical structure of metallic substances. The behaviour of materials of construction under the stresses to which they must inevitably be subjected, has involved a wide consideration of such matters.

The reaction of materials of construction to the stresses acting on them has involved also the necessity of utilising the assistance of the pure mathematician. The view of a few years past, that matter was not profoundly affected by the rapidity and periodicity of the stresses to which it was subject, has been corrected. The importance of this will be seen when it is remembered that apparently strong structures can be so weakened as to break under comparatively small but repeated stresses; thus there have been unanticipated breakages in bridges and machinery; for example, the propeller-shafts of an ocean-going vessel.

The extension and difficulty of the literature treating of the behaviour of materials subject to distortion are vastly greater than is popularly supposed ; in fact in the higher regions of this field it is only students possessing a considerable command of higher mathematical knowledge who are really capable of understanding the changes which take place, or their true significance. The safety of human life, it will be seen, is sometimes largely dependent upon the accurate solution of problems which initially might have seemed to have a very remote connection therewith.

This will suggest, in a general way, the importance of endeavouring to reduce all empirically known facts to a system ; and, indeed, technical resourcefulness depends largely upon success in this matter.

4. *The Interdependence of Various Forms of Knowledge.*—Those who have given technical education no due consideration are apt to conclude that many subjects insisted upon, the connection of which with the end in view is not to them very obvious, are of little utility. Incidentally it may be remarked that certain parts of all technical courses are advisedly disciplinary ; their real function is to strengthen the intellectual power and to accustom them to the mode of attack on problems of difficulty. In *all* technical education this is important, but particularly so in its higher branches. The wide examination of the curricula in technical institutions throughout the world will disclose the fact that some of the intellectual demands made upon the pupil or student are severe. The justification of this, however, will become clear if a little close inspection of the illustrations in the preceding section of this chapter be given.

First of all it will be noticed that there is no royal road to the solution of urgent problems that present themselves in technology. Consequently the training of the higher technical school must be such as to habituate the mind to the attack of apparently insoluble difficulties. Then again, the treatment of the various subjects must be wide in outlook. If it be otherwise, a type of practitioner will result who can simply repeat the performances of the past. A mere imitator, without initiative, or one who is without genius, in the endeavour to anticipate new conditions, to originate new technical processes, or suggest new applications of those already existing, would be all one could hope to produce

With a development of each science, its interdependence on others comes more clearly into prominence ; not one stands alone ; hence it is necessary for the scientific foundation of the technologist to be extensive, so as to ensure wide horizon and a high degree of alertness in regard to the intellectual powers. It is from this point of view that we realise that no hard and fast line can be made

between

between many of the sciences, a fact indicated even by the terminology necessary to define the functions of the modern technologists or members of the modern technical professions. Originally "engineer" had a somewhat restricted meaning; now we have such forms of engineering as agricultural, architectural, civil, mechanical, railway, marine, etc.

Very little attention to the changes in the modern world will disclose the need for this. The conditions of agricultural science in Europe have shewn that there is a considerable region in which the distinction between "agricultural" and "civil" engineering is unmeaning. The agricultural engineer advises on all questions of drainage, the necessary works to be undertaken in connection with the most profitable agricultural exploitation of any area, the structures and machinery which might profitably be raised and used in connection therewith, thus clearly trenching on the functions of the civil and hydraulic engineer.

The chemist, as such, is competent to deal with chemical questions, mainly upon the basis of their realisation on the laboratory scale. The ordinary technical chemist may have a general idea of what type of structure is required, but is mainly concerned with its utilisation. The chemical engineer, on the other hand, because he is both engineer and chemist, is qualified to deal with the development of the larger apparatus of chemical industry and the whole scheme of chemical manufacture. And similarly with others. There is no hard and fast division between the function of the architect and that of the civil engineer, and with their mutual development it has become more and more necessary that the architect should have a real knowledge of construction from the engineering standpoint, and on the other hand not a few structures designed by the civil engineer sufficiently testify to the fact that an advance in his artistic education would not be without advantage, especially when he is called upon to erect structures in which the æsthetic element ought to be a conspicuous feature.

5. *Technical High Schools and Universities.*—Throughout Europe the prevailing tendency is to relegate the highest form of technical education to the technical high school, which is, in reality, a technical university. In England, on the other hand, although there is to some extent also a similar movement, the prevailing tendency is to domicile higher technical education in the University itself. The same may be said of America.

Either practice has advantages and disadvantages. The dense populations of Europe give an opportunity for the establishment not only of large universities, but also of technical high schools independent of them. To understand the advantages and disadvantages, even where this condition applies, it is necessary to have regard to the Continental view of the function of the University. Initially we must take account also of the fact that the preparation in the *Lycées* and *Gymnasien* is of a very high character, and the elementary grades of scientific knowledge are imparted before entrance into the University, whereas although the movement in that direction is being made, this has not been strongly insisted on in Universities developed under English influences. The *prevailing* impression in England is that a classical preparation is of transcendent importance.

There was perhaps a tendency, originally, to regard the University as a centre of universal erudition, the predominant element being undoubtedly the record of the achievements of the past. Now, however, the wealth of material coming from the investigation of Nature being so great, the centre of gravity so to speak, is changing; more and more the conception is strengthening that a University must also be the focus of the effort to explore the unknown fields both of philosophy and science. And the difference between the cultivation of the art of applying ascertained truth and that of discovering new truth is coming into clearer prominence.

A very large number of Universities are really a combination of the ideals of the German University, and of the German Technical High School; this is especially true of the more modern of the Universities of the United Kingdom. They provide for liberal education on the one hand, and for higher technical education on the other.

It ought, however, to be pointed out that the function of the University is facilitated or hindered, it may even be modified, by the conditions in the schools preparatory therefor. In fact, it is from this point of view that one sees the importance of the proper organisation of secondary education, a question which was dealt with at some length in the second report of the Commissioners.

This essential difference between University and Technical High School will now be more explicitly referred to.

6. *Characteristic of the University.*—The difference of the cast of instruction in the University and Technical High School expresses itself both in the *personnel* of the teaching-staff and in the method of teaching. Wherever there is adequate preparation for entrance into a University, the teaching ought to approach the plane of the highest achievement. The object of the University is to stimulate and guide the highest effort. For this reason a professor in a University need not necessarily be excellent from the standpoint of the popular lecturer. He should, however, be original, and capable not only of keeping himself *au courant* with the latest advances in his department of knowledge, but also of personally contributing thereto. Ability to add new elements to the knowledge of a subject, *i.e., the genius of research*, has first place in continental estimation; capacity as a lecturer is far more humbly rated. In his daily work, success is appraised on the basis of the quality and quantity of the original research carried out. It is that which gives eminence to its graduates, not their mere erudition. Hence the fundamental idea of the University is not so much a place where there are facilities afforded to keep in touch with achievements elsewhere, but where the original powers are stimulated in the highest degree, where method and habit are cultivated, and where new discoveries are made.

It is at once evident that this must govern the whole scope and scheme of the work of a University.

7. *Characteristic of the Technical High School.*—In a technical high school it is certainly, as in the University, the business of the teaching staff to afford the students every opportunity of keeping in touch with achievement throughout the world, in the sphere of each special subject. But the *teaching art*, in this type of school, is, perhaps, more important, and still more the genius of applying scientific knowledge to agriculture, industry, commerce, etc.

The reading and acquaintance with pure science, must, it is true, be *liberal*. Throughout the abler schools of the world this is strongly insisted upon, and though the path of qualification becomes more tedious and difficult, the training is correspondingly more valuable. In

In a technical high school it is most important that initiative be developed; that the student acquire not merely a knowledge of technical or professional matters, but also the power to apply his knowledge under new conditions. It is customary, therefore, in well organised technical schools, to call upon the student for the exercise of initiative. He has exercises of progressive difficulty in design, or in the attack of actual, or of supposititiously occurring problems.

Again, though pure science is taught, either a definite orientation is often given to it, disclosing its application, or it is taught in connection with its applications.

Technological education therefore tends to develope the talent of making use of the scientific foundations on which the technical superstructure is, so to say, built, rather than the genius of research and discovery. It fosters the inventive faculty, rather than that with which the natural philosopher is endowed.

8. *Importance of Detailed Curricula.*—In the preceding Reports of the Commissioners detailed curricula are given, in the case of secondary education at considerable length. From the popular point of view these may not be interesting reading, but for any serious student of educational systems, they are informative. And at least they serve the purpose of disclosing our relative position, and afford grounds for a real comparison.

It is perhaps well to bear in mind that specialism is very highly developed in European educational circles. The ideal is a wide general education as a foundation, and a thorough special education as the superstructure.

Attention is called to the thoroughness of the organisation of the material of instruction. The "Institut National Agronomique" of France may be taken as a type. The entrance conditions, and the development of the detail of every subject shew the care with which the elements are articulated.

But not only have curricula been given, attention has been drawn in several instances to the splendid equipments of the various laboratories. These are costly, but it is widely recognised that they are essential to efficiency, and that lavish expenditure, if wise, is, after all, a good economy when ultimate results are kept in view.

9. *Concluding Remarks.*—The preceding general remarks will serve to suggest the point of view from which the scope of the whole matter will be justly appreciated.

The range of the Commissioner's study is much wider than disclosed in the following chapters, but they are sufficient to give a general indication of the organisation of higher technical education throughout the world.

A point that may be accentuated in these closing remarks is, that now it is coming to be recognised that in professional education time should not be wasted merely in becoming manually expert, except where expertness is an essential in practice. A professional mechanical engineer is not an engineering mechanic, and it is easy to waste valuable time in the manual part of the subject. The true aim is to so profit by the manual part of the instruction, as to have a more vivid touch with its realities. Drawing has a high importance, therefore; but manual dexterity in the engineering shop is not a desideratum.

The following chapter will give some idea of the diversity and agreement among the various organised courses in technical instruction.

CHAPTER XXX.

Some Higher Forms of Technical Education in France.

[G. H. KNIBBS.]

1. *Introduction.*—The highest grade of scientific and technical instruction in France is, of course, to be found in the Faculties of Science of the French Universities and in the "*Ecole pratique des hautes études.*" For example, in the University of Marseilles there is a chair in industrial physics, and another in industrial chemistry, as also at the University of Bordeaux and that of Nancy. At the Lille University there is a chair in general and applied chemistry, and one in chemistry applied to industry and to agriculture; this last is represented also in the University of Lyons. Agricultural chemistry is a subject represented by a chair at the University of Nancy.

The higher forms of agricultural education will be discussed later, viz., in Chapters XLIV and XLV.

The lower forms of technical education have been considered in earlier chapters of the Report.

The object of this chapter is to refer briefly to some few of the more renowned technical schools of France. It does not, however, propose to review the higher grades of technical education in any general way, or to give a general account.

2. *The Conservatoire des Arts et Métiers, Paris.*—The great industrial museum and teaching institution known as the Conservatory of Arts and Crafts in Paris, was founded by decree of the Convention in 1794, having in view the higher technical instruction of the working classes. The idea was conceived by Descartes (1596–1650) and realised by the celebrated engineer *Vaucanson*, who bequeathed his collections to the State in 1783.

The various rooms (*salles*) contain collections, models, scientific apparatus, etc., in every department of the arts and crafts. For example, there are models of mines, tools, machinery, and apparatus for sinking mines, specimens of minerals, models of the Creusot ironworks, models of artillery, turret-forts, etc.; models of ironworks and foundries, cabinets containing ore, raw iron, etc.; apparatus for forging and welding iron, iron and steel rolling and forging, models of workshops of various kinds, illustration of wood industries, various large pieces of machinery, printing-machines, ploughs, agricultural implements generally, anatomical specimens of domestic animals, specimens of grain and fruit, models of buildings and technical constructions of every description; building materials, tools, models of factories; instruments for geometry and drawing, instruments of precision, chronometers, clocks and watches ancient and modern; weights and measures, Lavoisier's apparatus, and many curious original machines and pieces of apparatus; mechanical recipients of power, such as wind-mills, water-wheels, turbines, etc. The railway collection includes a model of the first locomotive with a tubular boiler, constructed by Marc Seguin in 1827. Among physical apparatus may be mentioned that for the investigation of liquid and gaseous bodies, electricity, magnetism, heat and meteorology, acoustics and optics, telegraphy and telephony. The are a number of turning-lathes and specimens of turned work, several machines by Vaucanson, tools and machine tools, motors, pumps, hydraulic machinery. Glass and pottery, and the chemical arts, such as dyeing and printing of textile fabrics and of wall-papers, are well represented. In industrial chemistry the arts of brewing, soap-boiling, candle-making, distilling, etc., are illustrated. Paper-making and typography, engraving, lithographic and photographic plant and apparatus, and machinery for spinning and weaving are very complete. In the "*Portefeuille Industriel*" in the northern part of the building may be seen multitudes of drawings of the latest machinery, for copying or study, and plans and specifications of expired patents are also kept in this quarter.

The courses established in the Institution are the following:—

Geometry applied to the arts.
Descriptive geometry.
Mechanics applied to arts.
Civil engineering.
Physics applied to arts.
General chemistry in its relation to industry.
Industrial chemistry.
Metallurgy and working in metals.
Chemistry applied to the dyeing, ceramic, and glass-making industries.
Agricultural chemistry and chemical analysis.
Agriculture.
Spinning and weaving.
Industrial political economy and industrial legislation.
Industrial economy and statistics.
Commercial law.
Industrial Electricity.—Study of the fundamental laws of electricity and magnetism from the special standpoint of their applications to industry. Laws of transmission of energy under all its forms by means of electricity. Apparatus for the measurement of electrical quantities. General theory of machines for the production of electric current by means of mechanical work or conversely.

Art

Art applied to the Crafts.—Recapitulation of the principles of artistic composition: Modern style. Examples taken from metal-working and from furniture.
Working in Clay.—Plastic and prepared potteries. Enamelled faiences. Stoneware. Porcelain. Architectural ceramics.
Glass Work.—Blown, cast, and moulded glass. Goblet making. Glass coloured *en masse* and enamelled glass. Glass windows and mosaics.
Textile Work.—Warp and woof. Decoration by weaving of the costume and furniture materials. Damask, velvet, decoration by printing. Embroidery, lace. Tapestries of high and low warp. Carpets.
Decoration of Books.—Engraving on wood and on leather. Illuminating. Application of the processes of photography. Bookbinding.
Metallurgy and Metal Work.—Processes and apparatus employed in metal-working. Forge with stamp and steam-hammer, rolling, drawing, etc. Machine tools. Construction of metallurgical furnaces.
History of Labour.—Course established by the city of Paris.
Social History of Steam.—Its applications, on the one hand, to railways and boats; on the other, to industrial and agricultural mechanism. Their economic, political, moral, artistic, literary influence.
Social Insurance and Providence—Course subsidised by the Paris Chamber of Commerce. The problem of workmen's pensions.
Social Economy.—Savings Banks: Their organisation in France and in foreign countries. Present questions.
Insurance.—Principles of insurance, mutual help societies, pension fund, insurance against accidents, on life, against enforced idleness.

In each course there are two lectures a week except commercial law and social economy, in which there are but one.

The last five courses have been established only since 1889.

The Chair of the *History of Industry is at the* charge of the city of Paris, which has transferred to the budget of the "*Conservatoire*" the necessary credit for this purpose.

The *Chair of Insurance and Social Providence* was established by mutual agreement of the State and the Paris Chamber of Commerce, who contribute each a sum of 5,000 francs per year toward its maintenance.

Free public lectures are given on important subjects by the professors of the Conservatoire.

3. *The Laboratories of the Conservatoire.*—The laboratories of the Conservatoire are intended for original research by the professors, in which the students are witnesses and collaborators. Nothing, it is held, can take the place of these exercises, which throughout have been unremittingly attended to.

Eight laboratories are devoted to the principal instruction, viz: (1) Mechanics; (2) physics; (3) general chemistry; (4) industrial chemistry; (5) chemistry applied to the dyeing, ceramic, and glass-making industries; (6) agricultural chemistry; (7) industrial electricity; (8) metallurgy and metal-working.

The celebrated works of General Morin and H. Tresca were executed in the mechanical laboratory. More recently, M. Hirsch had conducted important researches in the province of engineering physics.

In the equipment of the laboratories, as well as in the courses of instruction, every effort has been made to keep in touch with modern industrial development. For example, *Industrial Electricity* plays an important rôle in the industrial activity of the present time, and it is no longer possible for the ordinary physicist to devote himself sufficiently to electricity without neglecting his proper sphere, viz., general physics. Hence specialisation has become necessary, and the *Conservatoire* has met this need by a corresponding development in its teaching, personnel, and appliances.

Metallurgy was introduced in 1890, in response to a recognition of its importance in modern civilisation. In the laboratory important results, among others, on the properties of aluminium bronzes have been obtained.

Rural Engineering has been abandoned, and a course in *Arts as applied to the Crafts* simultaneously instituted, modern conditions demanding that more attention should be paid to the artistic features of handicrafts.

The laboratories have rendered admirable services to the extension of knowledge, since they are experimental, and are in charge of highly-educated and trained men. The laboratory for the course in mechanics is supplemented by that for industrial investigations or experiments. The electric furnace of the electric laboratory is known for important scientific work done therein—reduction of refractory metallic oxides, preparation of carbides, production of diamonds, etc.

The general and financial conditions of the *Conservatoire* has recently been greatly modified by the finance laws and some subsequent decrees. By the decree of 19th May, 1900, a laboratory for mechanical, physical, and chemical researches has been added, and again by the decree of 9th July, 1901, a national office for patents and trade marks has been added to the *Conservatoire.*

Extensive additions are also being made to the buildings.

4. *Administration of the Conservatoire.*—By the decree last mentioned the *Conservatoire* is placed under the authority of the Ministry of Commerce, Industry, Posts and Telegraphs, and is controlled by a Council of Administration and a Director (*directeur*) assisting by an Improvement Council for the instruction, and two technical Committees, viz., one for the research laboratories and one for the patents' and trade-marks' office.

The Administrative Council is composed of eighteen members, viz.:—

The Director of the "*Conservatoire national des arts et métiers.*"
The Director of technical education in the Department of Commerce.
The President of the Municipal Council of Paris.
The President of the Commission of Education of the Municipal Council of Paris.
The President of the Paris Chamber of Commerce.
The President of the Society of Civil Engineers.

A senator appointed for four years by the decree of the President of the Republic, on the proposition of the Minister of Commerce.

Five members selected from the learned bodies, the public services and industry, nominated for four years by decree of the President of the Republic, on the proposition of the Minister of Commerce.

The Director of the Research and Testing Laboratory at the Conservatoire.

The Director of the national office of Patents and Trade Marks.

Three professors of the Conservatoire elected for four years by the titular professors of Chairs and chosen from among them. Three delegated substitutes are elected at the same time by the professors for the purpose of temporarily sitting in the Administrative Council should the delegated professors be absent or be prevented from attending.

The *Administrative Council* deliberates on the following matters, viz.:—

(1) The acquisitions, alienations, and exchange of property of the Conservatoire.
(2) Loans.
(3) The acceptance of gifts and legacies.
(4) The offers of subsidies.
(5) The employment of credits and subsidies intended for the material of the *Conservatoire*, and their division between the various "*services*" of the establishment.

The *Improvement Council* attends to:—

(6) The general organisation of the courses and lectures and the programmes of the courses.
(7) The acquisitions of machines and models for the collections.

The *Technical Commission of the Testing Laboratory* attends to:—

(8) The acquisitions of machines and apparatus for the laboratory.
(9) The charges to be made for the various kinds of testing.

The *Technical Commission of the National Office of Patents and Trade-marks* deals with matters concerning:—

(10) The organisation and function of the national Office of Patents and Trade Marks.
(11) The days and hours when the consultation rooms of patents shall be open to the public.

The *Administrative Council* gives its advice on the following matters:—

(1) The budgets and accounts of the staff of the *Conservatoire.*
(2) The improvements to be made in the buildings of the *Conservatoire*, and upon new buildings.
(3) Questions submitted by the Minister.
(4) The creation, transformation or suppression of Chairs paid out of State funds.
(5) The designation of the Chairs, the laboratory of which should have assistance (*i.e.*, the services of a *préparateur*).
(6) The mode of publication of patents and the price to be fixed for the pamphlets offered for sale.

The *Technical Commission of the testing laboratory* is appointed for four years by the Minister of Commerce, and includes the following:—

A member of the administrative council, president;
The Director of the laboratory;
A titular professor of a course relating to the operations of the laboratory.
A member of the National Bureau of Weights and Measures.
A representative of the Ministry of Public Works.
A member selected from the learned bodies, the public and industrial services.
A member chosen from among the directors of the private testing laboratories.
Two members of the Paris Chamber of Commerce.

The *Technical Commission of the Office of Patents and Trade-marks* is appointed for four years by the Minister of Commerce, and comprises the following:—

A member of the Administrative Council, as president.
The director of Commerce and Industry at the Ministry of Commerce, of Industry, postal, and telegraphic departments.
The director of the National Office of Patents and Trade-marks.
A titular professor of a Chair relating to industrial legislation.
A member of the legal profession (*juriconsulte*).
A representative of the French Association for the Protection of Industrial Property.
Two members of the Chamber of Commerce of Paris.
The services of a secretary, chosen from the staff of the office is at the disposal of the Commission.

The *Director of the National Conservatoire of Arts and Crafts* is charged with the maintenance of the regular working of all the services, and is a member *ex officio* of the Council of Improvement, of the two *Technical Commissions*, and in general of all the committees at the *Conservatoire.*

The above sketch will give a general idea of the character of the "Conservatoire" and its scheme.

5. *Central School of Arts and Manufactures, Paris.*—The "*Ecole centrale des arts and manufactures*" was founded in 1829, and till 1857 was a private establishment. The total value of the land, buildings, collections, etc., is about 11,000,000 francs, say (£440,000).

Pupils are admitted only by examination to the three-year course of the school, and the conditions of admission are the same for foreigners as for the French themselves. The yearly admission is about 250.

The object of the school is to educate engineers for all branches of industry, public works and mines.

The *diploma* of engineers of arts and manufactures are delivered to those who pass all examinations. Certificate (*de capacité*) are issued to those who have shewn that they have profited by the teaching as a whole.

The

The scheme of work is as follows :—

Two lectures, $1\frac{1}{2}$ hours each	8·30–12·0
Lunch and rest	12·0– 1·0
Drawing, laboratory work, etc.	1·0– 4·0
Military exercises and science	4·0– 6·0

Weekly examinations are held on the part of the courses being taken, and a final general examination.

The principle governing the instruction is:—"Industrial science is a unity; every industrial worker must know it in its entirety, or remain unworthy of his task." Consequently each pupil follows the same course initially. Specialisation does not take place till well on toward the end of the second year, when there are four branches—Mechanicians, engineers, metallurgist-miners, chemists. But even in these the specialisation is limited, each pupil taking the same subjects. Thus a chemist would work in the mechanical laboratory and a mechanician in the chemical laboratory.

This scheme of ensuring a purview of the entire field of industrial science is one on which particular stress is laid, and is characteristic of the school.

6. *Courses in Ecole Centrale des Arts, etc.*—The courses cover the following ground :—

1st Year.

1. Mathematical Analysis.
2. Kinematics.
3. Thermodynamics.
4. Descriptive Geometry.
5. General Physics.
6. General Chemistry.
7. Mineralogy and Geology.
8. Construction Mechanism.
9. Architecture "civil" construction.
10. Industrial Electricity.
11. Hygiene and Applied Natural Science.
12. Industrial Technology.

2nd Year.

1. Applied Mechanics.
2. Work in Metals.
3. Machinery, construction and installation.
4. Industrial Physics.
5. Industrial Electricity.
6. Steam Engines.
7. Analytical Chemistry.
8. Applied Mineralogy and Geology.
9. Industrial Technology.
10. Architecture, "civil" construction.
11. Legislation and Industrial Economy.

3rd Year.

1. Applied Mechanics.
2. Machinery, construction and installation.
3. Industrial Chemistry.
4. General Metallurgy.
5. Metallurgy of Iron.
6. Mining Exploitation.
7. Public Works.
8. Railways.

Each course is connected with a large amount of drawing, testing, laboratory work, in the various departments, etc.

The distribution of time is as follows :—

Years.	Lectures. ($1\frac{1}{2}$ hours each.)	Drawing, etc.	Practical work.	Spec. Exam.	Gen. Exam.
	hrs.				
I....	397 = 596	432	99	22	10
II....	390 = 585	66	434	23	10
III...	318 = 477	...	467	20	7
Totals	1,105 1,658	498	1,000	65	27

7. *School of Mines, St. Etienne.*—Though its present organisation was fixed by the decree of 18th July, 1890, the "*Ecole des mines de Saint-Etienne*" was created as far back as 1816. It replaced the "*Ecole des mines de Paris,*" created in 1794, and extinguished in 1802. The work of this school will afford an illustration of the grade of teaching in the higher technical schools of France.

The courses extend over three years, and have for their object the education of engineers and directors of mining and metallurgical establishments. The instruction is gratuitous.

The school is administered by a director aided by an assistant-director, the former being appointed by the Minister.

The ages of pupils must be not less than 17 nor more than 26, and admission is by examination. Pupils of the "*Ecole Polytechnique*" enter at once on the second years' work.

The courses embrace lectures and practical exercises, viz. :—

Chemical practice, drawing, descriptive geometry, stereotomy, designing, plans of machinery, study of mineralogy, geological field work, visits to industrial establishments.

The subjects treated are—

First Year.
Mathematical Analysis.
Rational Mechanics.
Applied Mechanics I.
Physics.
Mineral Analysis I.
Mineralogy.
Perspective and Stereotomy.
Plan Drawing.
Practical Exercises.
Visits, Excursions, I.

Second Year.
Exploitation of Mines.
Metallurgy I.
Applied Mechanics II.
Construction.
Mineral Analysis II.
Geology I.
Practical Exercises.
Visits, Excursions, II.

Third Year.
Metallurgy II.
Geology II.
Electricity.
Railways.
Mining Legislation and Industrial Economy.
Accountancy.
Botanical Palæontology.
Practical Exercises.

A description of the details is necessary to give any idea of the thoroughness of the courses. These are as follow hereinafter.

8.

8. *Mathematical Analysis.*—There are in all twenty-one lectures, seven dealing with the differential calculus, including formation of differential equations, applications and resolution of the equation

$$\frac{d^2 V}{d t^2} - a^2 \frac{d^2 V}{d x^2} = 0.$$

and maxima and minima.

Six lectures deal with the geometrical applications of the differential calculus, in three dimensions, theory of developable surfaces, various plane and tortuous curves, geodesic lines and curvature. Five lectures are devoted to the integral calculus, and three to differential equations, of the first order and simple forms of the second order. The reduction of one system to another when particular solutions are known, the treatment of the case where the characteristic equation admits of imaginary roots, equations with partial derivatives, etc., etc., are discussed.

9. *Rational Mechanics.*—There are twenty-five lectures in all. These start with the general theory of vectors and vector systems (three lectures), and then proceed to kinematics, statics, dynamics, etc. The complete division is—

(I) Kinematics. (II) Principles of Mechanics. (III) Statics and dynamics of a material point. (IV) Statics of material systems. (V) Dynamics of material systems. (VI) Friction.

The development of these is as follows:—

(i) Definition and preliminary ideas: Examples of movements of a material point, and of an invariable material system. (ii) General formulas of kinematics, change of the system of comparison. Velocity, acceleration, in their various forms. (iii) Notion of force, principle of inertia, work, potential, level surfaces. Equilibrium. Equations of motion. D'Alembert's principle. Inertia. General theorems. Quantity of motion. Kinetic energy. Stability. Gravity. Motion *in vacuo.* Universal attraction. Deduction of Kepler's laws by Newton. Resistance of medium. Motion under central forces. Motion of a point on a fixed surface, on a fixed curve. Intrinsic equations of motion Equations of kinetic energy. Relative motion. Apparent gravity. Theory of units, fundamental and derived. Dimensions, homogeneity, similitude. (iv) Theory of *centre* of gravity. Guldinus' theorem. Principle of virtual work. Six conditions of equilibrium. Of solid bodies. Lagrange's co-efficients. Potential. Torricelli's principle. Statics of various material systems. Of solid bodies. Of connected systems. Polygons and funicular curves. Attractions of spheres. (v) General dynamic theorems. Conservative systems. Complete determination of motion. General equation of dynamics. General theorems deduced therefrom. Moments of inertia. General theorems. Ellipsoid of inertia. Motion of solid body about a fixed axis, about a fixed point. Euler's equation. Poinsot's method. Gyroscopic motion. Most general motion of a solid. Precession and nutations of equinoxes. Relative motion. Dynamics of systems. Impact and percussion. Quantity of motion lost by centre of gravity. Direct impact, balistic pendulum. (vi) Friction, its various kinds. Systems with friction. Discontinuities in equations of motion.

10. *Applied Mechanics.*—There are twenty lectures in this subject, which is divided into two parts, viz.:—I. Mechanisms, and II. Hydraulic and pneumatic machines.

I is divided as follows:—Preliminary ideas, realisation of rectilinear motion, of motion about an axis. Transmission by articulated systems, by flexible connections, chains, cables, belts, etc. Transformation of one continuous circular motion into another, of a rectilinear into a rectilinear or circular. Transmission by water or air; by friction. Toothed wheels, cylindrical, conic, etc. Friction and resistance. Helicoidal wheels Hyperbolic gearing. Trains of wheels. Cams, eccentrics, ratchets, etc. Lubrication, vegetable, animal, mineral substances. Testing and apparatus for same. Indicated work. Watt's indicator and its errors. Deprez's. Optical indicator. Indicator curves. Clapeyron's diagrams. Work on shafting. Prony's dynamometric brake. Work transmitted to any operating machine. Traction and rotation dynamometers.

Rapid calculation. Graphics. Area calculation. Planimeters.

Machine tools. Generalities. Description of principal machines.

II is thus developed:—Rational mechanics of fluids. Principles of thermo-dynamics. Change of state and change of position. Equations of equilibrium. Compressibility. False equilibrium. Equation of energy. Carnot's cycle. Entropy, etc. Entropy diagrams. Statics of fluids. Internal pressure. Differential equations of the pressures in a fluid in equilibrium. Liquids. Archimedes' principle. Stability of flotation. Dynamics of fluids. General equations of motion. Permanent motion and equation of conservation of energy. Zeuner's and Bernoulli's equations. Viscosity.

Hydraulics, simplifying hypotheses. Apparent viscosity. Flow with loss of head. Pipes and channels. Resistance of fluids. Impact. Dubuat's paradox. Gauging and instruments for same.

11. *Physics.*—There are twenty-three lectures in physics. These relate to thermo-dynamics, conduction, etc., of heat, acoustics, optics, and radiant heat. The detail is as follows:—Dilatation, change of state, characteristic equation of fluids, Surrau's and Van der Waal's formulas, density of vapour, etc. Calorimetry, specific heat. Adiabatic expansion, etc. Delaroche and Bérard's law. Heat of fusion and vaporisation. Mechanical, kinetic, and potential energy in thermo-dynamics. Equivalent by Joule, Hirn, Violle, etc. Representation of mechanical work, heat put into play, internal energy, cycle of changes, etc. Kinetic theory of perfect gases. Economic co-efficient. Identity of Carnot's and Clausius' principles. Variation of entropy in a reversible transformation from the standpoint of mechanics. Thermo-dynamic scale of a thermometer. Equation of Clapeyron-Clausius. Dissipation of energy. Characteristic function of Massieu. Superheating, etc. Fourier's theorem and its applications. Acoustics, and the general theory of vibrations and their propagation. Optics. Laws of reflection and refraction in isotropic substances. Dispersion. Colour spectroscopy. Phosphorescence. Fluorescence. Velocity of light. General theory of emission, interference, diffraction, polarisation, double refraction, chromatic polarisation, light in a biaxal crystal, optical axes. Crystals in convergent beam. Rotatory magnetic polarisation. Radiant heat dark spectrum Emission and absorption.

12.

12. *Mineral Analysis.*—There are thirty lectures given in this subject. It begins with generalities, the general methods of qualitative and quantitative analysis, dry and wet way, sampling, mineralogic and metallurgical analysis.

Qualitative analysis deals with volatilisation, solution, precipitation, special determination of elements, the metalloids and metals, analyses of solutions and solids.

Quantitative analysis treats of general practice, operations by solution, gravity methods, volumetric methods, electrolytic methods. The more important gases, metalloids, and metals, organic and combustible matters are treated in detail. The last two lectures deal with iron and steel, the carbon, silicon, phosphorus, sulphur, manganese, chromium, and tungsten content.

13. *Mineralogy.*—To this subject twenty-four lectures are devoted.

The organoleptic characters of minerals, their crystallographic characters and crystallography, the systems of Miller and Lévy, study of the seven systems, relation of internal property to crystalline symmetry.

Chemical characters of minerals, experiments with blow-pipe. The oxygen, nitrogen, and carbon families of the metalloids. The silicates, anhydrous protoxides and sesquioxides, hydrated silicates, protoxides, and sesquioxides. Metals. Family of alkaline metals and their salts. Metallic earths and alkaline earths. Uranium, mercury, copper, silver, gold, platinum. All these are taken in great detail.

14. *Perspective and Stereometry.*—To these subjects twenty-four lectures are devoted. The course is thus developed :—

Supplements of descriptive geometry. Ruled, developable, and skew surfaces. Skew surfaces of the second degree. Skew hyperboloid, etc. Intersections of surfaces. Shadows. Shadows proper, shadows cast on objects, illumination of surfaces, contours of equal depth of shade.

Perspective of figures and round bodies. Apparent contour. General problems in perspective. Rapid perspective. Isometric perspective, etc.

Stereotomy applied to wood and stone. Constructions, joints, etc., in wooden structures. Stone-cutting, etc. About six lectures are devoted to the former, and seven to the latter.

15. *Surveying.*—Twelve lectures are devoted to this. These are as follows :—

(1) *Geodesy and Topography.*—Survey. Case where it is necessary to take account of the rotundity of the earth, for example, in piercing certain tunnels. The determination of the astronomic meridian, etc., is also in the province of geodesy; where it is necessary to solve spherical triangles. Elements of spherical trigonometry. Fundamental formulæ. Solution of right and oblique angled triangles.

(2) *Geodesy.*—Measurements of lengths, definition of azimuthal and zenithal angles. To reduce an angle to the horizon. The three geographic co-ordinates, determination of one point in relation to another.
Geodetic triangulation.
Construction of maps by conical development, by stereographic and orthogonal projections.

(3) Determination of the *astronomical meridian.* Use of stars. Theorem of equal altitudes. Tracing the meridian by the method of equal altitudes, by elongations of circumpolar stars, by one or two observations of the sun.

(4) *System of representation* by plans, etc. Point, line, plane. Applications to subterranean surveying.
Determination of topographical relief by decomposition into "facettes," by level contours. Remarkable lines. Watersheds. Various applications. Longitudinal sections (profile) and cross-sections. Drawing of topographic relief.

(5) *Topographic plans*, conventional tints, drawing of ordinary cultivations. Writing on plans, scale. Copy, reduction. The pantagraph. The two elements of survey, planimetry, hypsometry. Planimetry. Details by abscissae and ordinates. Polygonal reticulation. Intersection methods. Directions, triangulations. Method of azimuths. Orientation of plans.
Relation of plans. Graphic methods, its inconveniences. Method of co-ordinates, its advantages. Calculations of horizontal co-ordinates directly from the elements of survey by the method of azimuths. Preliminary calculation in survey by means of a goniometer. Problems.

(6) *Survey practice.*—Alignments. Horizontal lengths. Metric survey. Plane table and its use. Square and cross staff. Testing and use. The same as regards the graphometer. The goniometer, excentricity of collimation. Conditions to be fulfilled in a perfect goniometer.

(7) Description of *essential parts.* Limb, vernier, level tubes; geodetic telescope. Repetition of angle. Verification of levels. Centring the telescope. Description of the *theodolite.* Relations of its essential parts, verification and adjustment. Setting up and use of theodolite. Reduction to centre. Theodolites with centred telescope.

(8) *Use of theodolite* in ascertaining the astronomic meridian. Height of north pole. Mode of observing centre of sun.
Surveying Compass.—Magnetic azimuths. Direction of graduation. Signs of angles read. Conditions of a good compass. Excentricity of needle, two readings 180° apart. Description, verification, and use of compass.

(9) *Hypsometry or Levelling.*—Apparent level. Operations, formulæ. Water levels, etc. Precise levels. Essential features: their relation of parallelism. Description, testing and adjustment. Egault's level. Lenoir's with independent bubble.

(10)

(10) Trigonometric levelling by inclination, etc. Level compass. Chezy's level, use. Stadia telescope. Anallatic telescope. Tacheometer and its use in survey, especially in mountainous country.

(11) *Mining Surveys.*—Hanging compass. Polygon, inclination, direction, and length. Precautions. Field-book calculations of horizontal and vertical values. Graphic calculations. Method of co-ordinates. Reversion of method.

(12) *Variations of magnetic declination* with time and place. Necessity of taking account thereof. Advantage of astronomic meridian. Various compasses. Survey of main headings, etc.

In the *second year* the following subjects are taken, viz.:—

13. *Exploitation of Mines.*—There are forty-five lectures in this subject, as follows:—

(1) Generalities, the earth's crust, and its modifications by aerial, aqueous, thermal, chemical, and general chemical causes.

(2) Prospecting. Geologic, palæontologic, petrographic "indices." Local mineralogic and archæologic indications. Magnetic indications. Thalen's magnetometer, inclination (dip) compass. MacEvoy's electric "*révélateur.*" Bores with rod, bores, etc.

(3) Classification of boring. By means of rods. Percussion-tools. Oeynhausen, Degoux and Laurent, Lippmann, Kind, Fabien, Dru. Scheme of operations.

(4) Boring by means of other tools. Boring with diamond.

(5) Artesian wells. Piezometric level and yield. Sinking, etc. Mode of working in soft and hard rocks. Use of appliances, iron, water, dilatation of cylinders of compressed quick-lime.

(6) Explosives of 2nd and 1st Order. Velocity of explosive wave. Mild and shattering explosions. Detonation. Theory of explosion. Initial pressure. Power of explosive. Experiments of MM. Nobel, Sarrau, Roux.

(7) Composition of explosives. Powder. Mercury fulminate. Picrate of lead. Diazobenzene nitrate. Nitrate derivatives of aromatic carbides. Nitrobenzenes and nitronaphthalenes. Nitrate derivatives of cellulose. Gun cottons. Nitroglycerine. Dynamites.

(8) Safety-explosives. Ignition temperature, a mixture of air and fire-damp. Mallard's and Le Chatelier's experiments. Conditions to be fulfilled by safety-explosives. Additions of ammonium nitrite. Safety-explosives with dynamite, gun cotton, nitrobenzene, or nitronaphthalene bases, etc.

(9) Storing of dynamite and explosives in general. The Blanzy experiments. Charges, cartridges, fuses, etc. Electric firing and its details.

(10) Borers, hand, compressed air, rotatory, percussion, etc., etc.

(11) Supports, timbering, etc. Significance of lack of homogeneity in strata. Fatigue of strata. Timbering under various conditions.

(12) Lining galleries, tunnels, etc. Brickwork. Masonry. Tunnelling and supports. Temperature. Methods in Mont Cenis and St. Gothard tunnels.

(13) Shafts. In water-bearing and dry strata, with brick or other walls.

(14) With metallic lining. Processes of Lisbet, Triger, Kind, Chaudron, Poetsch.

(15) Subterranean exploitation. Generalities. First disposition, number and position of shafts, order of exploitation, principles and classification of methods.

(16) Seams, lodes, etc., and method of dealing with them.

(17) Coal seams, mode of working thin seams.

(18) Moderate seams. Mode of working, "long wall," panel-work, pillar and stall system, etc.

(19) Great seams. Methods of working. Blanzy's, Fayol's, and other methods.

(20) Continuation of above.

(21) Exploitation of strata, etc., of small value. Open-air exploitation.

(22) Transportation to the surface. Aerial transportation. Hodgson, Balan, Lingerwood, Miller, Otto-Bleichert systems. Electric system of Jenkin and Lambs. Aerial monorail.

(23) Subterranean transport. Various methods. Mining railways.

(24) Rolling stock. Mechanical traction, endless cord, etc.

(25) Inclined planes, cables, pulleys, brakes, safety appliances, velocity-regulators, signals, etc. Motor power, animals, compressed water, steam-compressed air.

(26) Cables round, flat, details.

(27) Cables with variable load, according to section. Manufacture of diminishing cables. Cables of vegetable fibre, of steel.

(28) Apparatus for extraction.

(29) Output, and mode of keeping tally. Loading.

(30) Regulating extraction. Coils.

(31) Drums. Counter weights.

(32) Appliances for extraction.

(33) Continuation. Ladders, cages.

(34) to (36) Drainage. Generalities. Pumping. Motors, double-action motors, rotary and centrifugal pumps, pulsometers, ejectors, etc.

(37) Aeration, ventilation, etc. Temperature. Vitiation of air in mines. Fire-damp. Chemical and physical properties. Combustion, velocity of flame. Slow and rapid disengagement of fire-damp. Pockets of fire-damp. In old workings. In mines other than coal mines.

(38) Air necessary. Murgue's formulæ. Natural ventilation. Furnaces.

(39) Aspiration and draught ventilators, details of ventilating and calculations connected therewith.

(40)

(40) General rules for aeration of coal mines. Measurement and control. Anemometers. Pitot's tubes. Fire-damp measurer.
(41) Lighting. Naked lamps. Safety-lamps. Davy lamp and its defects. Clanny and Boty lamps. Fumat's, Mueseler's, Marsaut's, Pieler's, Chesneau's. Accidents. Fire in a mine. Apparatus for entry into irrespirable air.
(42) Mechanical preparation of minerals and coal. Classification. Crushing, etc.
(43) Washing fine sands. Jigs, etc. Horizontal current appliances.
(44) Tables, buddles. Wasting and amalgamation.
(45) Treatment of coal, etc., etc.

17. *Metallurgy.*—There are thirty-five lectures in metallurgy dealing with the following :—

(1) Generalities, and metallurgical processes (fire and wet way), sampling, etc.
(2) Chemical agents and various reactions, mechanical and electric energy.
(3) Calorific energy.
(4) Combination, gas furnaces, etc.
(5) Furnaces, ordinary, blast, reverbatory, etc.; preparation of refractory materials, construction of furnaces.
(6) Accessories of furnaces, flues and chimneys, blowers, combustible materials, vegetable and mineral, turf, lignites, coals, anthracites, etc.; petroleum and natural gas.
(7) Carbonized material, wood charcoal, coke, carbonizing furnaces.
(8) Artificial gaseous combustibles, the gas of coke furnaces, distillation of coals, manufactured gas from water, combustibles, with volatile elements, various forms of gas furnaces.
(9) Heat lost in metallurgical furnaces, sensible and potential heat of the gases of such furnaces, increase of the temperature of combustion, Ponsard, la Chomette furnaces, Calder apparatus, Siemens' furnace, Cowper, Whitwell apparatus for draught at high pressure.
(10) Metallurgy of iron, iron materials, roasting.
(11) Iron alloys, general properties of irons and steels, influence of the proportion of carbon and cast-iron steel, etc.; the effect of silicon, phosphorus, sulphur, manganese, chromium, tungsten nickel, copper, arsenic, antimony, aluminium, oxygen, etc.
(12) Manufacture of cast-iron.
(13) Relations between the castings and slags, composition of slags deduced from the fusibility of silico-aluminates, ideal working of the high furnace.
(14)–(19) Furnaces, thei raccessories and working.
(20) Manufacture of irons and steels.
(21)–(31) Manufacture of various forms of iron and steel, puddling, the Langlade, Harvey, Piezka, and other furnaces, Bessemer and Martin-Siemens' processes.
(32)–(33) Forging, etc.
(34) Mechanical work with cast metal.
(35) The properties of irons and steels and their testing.

18. *Applied Mechanics*, Part II.—There are forty lectures on this subject, which run as follows :—

(1) and (2) deal with generalities, water canals, equations of energy, motors, water-wheels, etc.
(3)–(5) Turbines, their details, construction, and operation.
(6) Hydraulic elevators, rotation machines, accumulators, etc., pumps.
(7) Rotatory pumps, centrifugal pumps, etc.
(8) Study of a perfect gas, its flow through an orifice, etc.
(9)–(10) Fans, air-compressors, etc., static ventilators, dynamic ventilators, the use of air-compressors, windmills, anemometers.
(11)–(23) Generalities regarding heat-engines, theory of saturated vapour, theoretical cycle of a steam-engine, high-pressures and superheated steam, poly-cylindrical engines, transformation of indicated to effective work.
(24) Foundations of machines.
(25)–(27) Fly-wheels, governors, etc., regulating the movement of hydraulic turbines.
(28) Condensation.
(29)–(32) General theory and description of the principle types of boilers, superheating, feeding.
(33)–(34) Principal types of machines.
(35) Hot-air and gas-engines, Stelling and Ericson's cycles.
(36) and (37) The combustion of mixtures utilized in various motors.
(38) and (39) Gas and petroleum motors.
(40) Refrigerating machinery.

19. *Construction.*—There are twenty lectures in this subject, covering the general theory of construction, the bending and compression of different members and other forms of deformation, the application of graphical statics, the elements of masonry, brickwork, etc., plaster, cements, concretes, foundations underneath water, machines for testing metals, etc.

20. *Mineral Analysis.*—There are fifteen lectures in this subject dealing with the following minerals, viz., those which contain cobalt and nickel, molybdenum and tungsten, zinc, cadmium, uranium and vanadium, tin, lead, bismuth, copper, mercury, silver, gold, platinum and the allied metals, examinations of minerals for lead, silver, gold, etc.

21.

21. *Geology*, Part I.—There are also fifteen lectures in this subject, dealing with the form, mass, and internal temperature of the earth, general physical geography, external and internal geo-dynamics and petrography.

22. *Metallurgy*, Part II.—The third-year courses commence with Metallurgy, Part II, in which twenty-four lectures are given. These commence with generalities, the importance of the rôle of silicates and metallurgy, classification of minerals, etc., and then pass on to roasting, the elimination of arsenic, antimony, tellurium, selenium, various kinds of furnaces, roasting and rotatory furnaces, the metallurgy of lead, its purification, of copper, German and English processes (dry methods), wet methods, electro-metallurgical processes, the metallurgy of silver, dry way, combination of wet and dry methods, the metallurgy of gold, of zinc (Belgian and Silesian methods), metallurgy of antimony, of mercury, tin, nickel and cobalt, platinum and allied metals, aluminium, electro-metallurgical processes in connection therewith.

23. *Geology*, Part II.—There are twenty-five lectures in this subject. It commences with animal palæontology, summarising the existing vertebrates. In the first five lectures the principal trilobites, the cephalopoda, belemnites, ammonites, gasteropoda, brachiopoda graptolites, foraminifera, radiolaria, etc., are referred to. In the sixth lecture stratigraphical geography is outlined, the general disposition of Caledonian, Hercynian, and Alpine zones being pointed out. The primitive crystalline rocks are dealt with in the seventh lecture. (8) Cambrian and Silurian. (9) Devonian. (10) Carboniferous and Permian. (11) Triassic. (12) Jurassic. (13) Cretaceous. (14) Tertiary. (15) Quaternary. (16) Lectures on tectonic theory dealing with folding, fractures, faults, etc. (17) General structure of mountain chains. (18) Plains. (19) Mineral strata, etc. (20) and (21) Formation of the coal region. (22) Metalliferous lodes, etc. (23) Iron and manganese. (24) Chrome, nickel, tin, antimony. (25) Copper, lead, silver, zinc, mercury, platinum, gold.

24. *Electricity*.—There are thirty lectures in this subject, developed as follows :—

(1) Preliminaries ; fields, lines, surfaces, and tubes of force, flux of force, laminar and solenoidal fields, equipotential surfaces.

(2) Karl Neumann's theorem, addition of fields, surfaces of discontinuity, application of the theory of laminar fields to universal gravitation, Gauss' theorems, field with a spherical shell and plane homogenous stratum, energy of a system.

(3) Static Electricity. Electrification by friction, influence, electric screens, electric charge, principle of conservation, superficial density, power of points, capacity, condensers, grouping in series and in parallel, Riess' theorems, electroscopes and electrometers.

(5) Use of the electrometer, dynamic electricity, electric current, chemical and thermo-electric cells, variation of potential, Ohm's law, electrolytic action, Joule's law, Faraday's law for derived currents, resistance, current density.

(6) Currents in conductors of three dimensions, Kirchhoff's and Adams' experiments, the heat through the Joule effect in relation to energy. Variation of potential in a circuit of electrolytes, electromotive force, Kirchhoff's laws, intensity of current and electric charges, power of currents thermo-electric phænomena, Peltier and Thomson effects.

(7) Thermodynamic theory of thermoelectric or chemical cells. Favre and Silbermann's experiments, Magnus law, thermoelectric power, formulæ of Tate and Avenarius, application of Carnot's principle, Nobili's cell, Lechâtelier pyrometer, radiomicrometer, Clamond's cell, fundamental facts of electrolysis.

(8) Laws of electrolysis, electrolytic and metallic conductivity, transport of ions, polarisation and depolarisation of electrodes, electrolysis of mixtures, polarisation capacity, applications to the refining of copper, manufacture of aluminium, hypochlorites, potassium chlorate, etc. ; electro-capillary phænomena, Lipmann's electrometer.

(9) Volta, Daniell, Callaud, Grove, Bunsen, Leclanché de la Lande and Chaperon, Grenet, cells. Planté, Faure and Commelin and Desmazures accumulators. Contact electromotive force, theory of electrostatic machines.

(10) Magnetism. Natural and artificial magnets. Influence of the earth. Coulomb's laws. Experiments of the divided magnet. Fundamental properties of a particular magnet. Magnetic moment. Gauss' experiment. Terrestrial magnetic field, its intensity, the moment of a magnetic needle, intensity of magnetisation, fictitious equivalent distribution. Interior magnetic force not determined. Magnetic force and induction. Magnetic force admits of potential. The induction force across a closed surface is zero.

(11) Cylindric magnets, closed magnets. Various expressions of the energies of a magnetic system Magneto-motive force. Equivalent sheets, potential energy, and magnetic induction of a sheet. Lamellar magnets.

(12) Electro-magnetism and electro-dynamics, Laplace's law. Action of a magnetic field upon an element of current. Laplace's law and Ampère's paradox, non-uniform potential of a linear current. Magnetic field of a conductor of three dimensions. Studies of the fields produced by a circular current, a cylindric or annular coil, an indefinite cylindrical conductor, reciprocal action of currents, unit of magnetic force, potential of a system comprising magnets and currents.

(13) Co-efficient of mutual induction and self-induction of two surfaces, magnetisation by influence, magnetic and diamagnetic bodies, permeability, residual magnetism, hysteresis, loss of work by hysteresis, Steinmetz' formula, determination of fields produced by permanent magnets or currents in the cases of perfectly soft bodies, theory of magnetic surfaces, refraction of lines of force and induction.

(14) Theory of induced magnetisation, rule for evaluation loss of energy by hysteresis. Application of the principle of conservation of energy. Distinction between energy of a system and the potential of the forces which it developes, induction phænomena, Lenz's laws, general law of induction, extinction of current, measure of the flux of induction, definition of the co-efficients of self-induction for conductors in the neighbourhood of magnetic bodies, distribution of induced electromotive force is indeterminate.

(15)

(15) Foucault currents, armatures and dynamos. Electro-statics, specific inductive power, polarisation of dielectrics, Maxwell's theory, displacement and displacement currents, capacity of a condenser, residual charge of condensers, usual form. Electric units, characteristic velocity, electro-magnetic and electro-static systems of practical units.
(16) Standards of resistance, electro-motive force, capacity. Measurement of intensity of current, tangent galvanometers, ballistic and aperiodic galvanometers, ampèremeters, electro-dynamometers, measurement of differences of potential and electromotive forces of measurement.
(17) Wheatstone's bridge, ohmmeters and wattmeters, energy recorders, measure of capacity, measure of permeability, hysteresis, etc., dynamo-electric machines, elementary dynamo, suppression of Foucault currents.
(18) Continuous current dynamo. Gramme ring, collector, curve of potential at collector.
(19) Electromotive force developed in the dynamo, torsion of the field, details of construction, winding, collector, etc., suppression Foucault currents.
(20) Brush and Thomson-Houston machine, bi-polar and multi-polar machines, various modes of excitation.
(21) Excitation in series, coupling of dynamos, motors with continuous current.
(22) Mechanical characteristics of motors according to the method of excitation, use of motors, variations of velocity in the direction of movement, generalities regarding alternating currents, Sinusoidal functions, phase, frequency, and pulsation; representation by means of vectors and imaginaries, fundamental properties, laws of Kirchhoff in the case of alternating currents, inductance, reactance, and impedance of a conductor. Influence of a condenser in series or in derivation.
(23) Continuous oscillating charge of a condenser. Extinguishing higher harmonics, efficient values of periodic functions, use of condensers, polarising condensers, localisation of alternating currents on the surface of conductors, measures of alternating current, electrostatic voltmeter and wattmeter, correction-factor, measurement of power by the method of 3-voltmeter, generalities on alternators.
(24) Uni-polar inductor, polyphase currents, alternators with polyphase currents.
(25) Electromotive force of an alternator, curves of electromotive force and intensity, oscillographs, synchronous motors, graphic study of them, characteristics of alternators, theory of coupling.
(26) Practical condition of coupling, polyphase currents, asynchronous motors or induction motors, cyclic self-induction, theory of asynchronous motors, motor couple.
(27) Definition of mutual cyclic induction of the inductor, etc., monophase asynchronous motors and their theory. Transformers.
(28) Closed secondaries, analogy with induction-motors, case of inductive secondary circuit, various types of transformers, polyphase current transformers, limit of power, Ruhmkorff coil, transformation of a simple alternating current into a two-phase current, and of a two-phase into a three-phase current. General case of transformation, rotatory transformers and converters.
(29) Systems of distribution with two or several wires, alternating currents, loss of voltage, aerial and subterranean cables, safety apparatus, fuses.
(30) Electric lighting, incandescent and arc-lamps, photometric efficiency, application of electricity to traction, various methods of taking current, use of accumulators.

25. *Railways* —There are fifteen lectures on this subject. These deal with rolling-stock; railway trucks; carriages, etc.; the fundamental equation of the locomotive; comparative study of high-speed locomotives and those for the transport of goods; the study of locomotives as steam-engines; the influence of slopes and curves on trains; resistance of the air and wind; hand, vacuum, and Westinghouse brakes; study of the road; the principal types of rails; wood and metal sleepers; the laying of the road; its ballasting; changes of slope; curves and their adjustment; points, turnouts, crossovers, etc.; principles determining railway routes; position of station; earthworks, bridges, viaducts, and tunnels; protection against snow; junction and terminal stations; goods sheds; main and branch lines; signals, locking systems; regular, optional, and special trains; commercial exploitation; State railways; concessions and tariffs; tariffs by distance, the Belgian system, zone tariff, tariffs at a fixed price; importance of a good determination of tariff in the interest both of the exploiter and the districts served by the railway.

26. *Mining Legislation and Industrial Economy.*—Fifteen lectures are given in this subject. These lectures cover summary ideas upon constitutional French law; the legislative and executive power and the promulgation of law; upon administrative law; acts of public authority and administration, direct and indirect agents, the President of the Republic; decrees; Ministers, ministerial regulations and circulars; Council of State, its organisation and sections; authorities of the "*départements*; the Prefect and Council of Prefecture; the general Council; "*départmental*" commission, under-prefect, Council of the "*arrondissement*," Cantons, communal authorities, Mayors, municipal council.

The above constitutes the first lecture. Only the headings of the others will be given.

(2) The Judiciary authority, administrative jurisdiction.
(3) Principal ideas of private right, appropriation in the public interest.
(4) Civil, commercial, and other societies.
(5) Mining legislation.
(6) Mining, prospecting, etc., mining concessions.
(7) Recourse against concessions, laws governing the granting of prospecting rights to foreigners, etc.
(8) General characters of mining property.
(9) Relations between the exploiter of a mine and others.
(10) Damages occurring through exploitation.
(11) Relation to the State.
(12) Administrative surveillance, mining police.
(13) Transformation of old concessions, iron mines.
(14) Mineral waters, unhealthy, dangerous, or inconvenient establishments, explosives.
(15) Social laws.
(16) Insurance of life and against accident. Old-age pension. Special rules regarding insurance institutions in connection with mining industry.

27. *Accountancy.*—Six lectures are given on this subject, dealing with general matters, associations, partnerships, etc., industrial accountancy, book-keeping, principles of the application of accountancy, organisation of industrial accountancy, etc.

28. *Vegetable Palæontology.*—Six lectures are given in this subject, referring to the utility of plant fossils for determining terrestrial formation in seeking for coal; to the periods and epochs of fossil vegetation, its classification, etc. The fossils belonging to different periods are dealt with very fully.

29. *General Remarks on the St. Etienne School of Mines.*—The very brief synopsis given will at least serve the purpose of disclosing the thoroughness with which the courses are developed, and may be taken as characteristic of the other technical schools of France.[1] The most cursory examination of the programme discloses the fact that the preliminary attainments must be high, and that the lectures are really of a very advanced type. The conditions for admission to this school confirm what has been stated. In the Commissioners' Report on Secondary Education, pp. 206–210, the programme for admission to the "*Ecole polytechnique,*" was given; this also clearly indicated the high character of the preliminary education demanded for French higher technical schools.

30. *Other Technical Schools.*—The "*Ecole polytechnique*" is intended to qualify artillerists for the army and navy, civil and naval engineers, hydrographic engineers, the naval commissariat, departments of bridges, roads, mines, etc., corps of engineers for the manufacture of explosives, for telegraphy, etc., or more generally for careers involving application of the natural sciences. This and other eminent higher technical schools in France are all splendidly equipped and organised, and their programmes without exception shew characteristic precision and clearness of development. Among these might be mentioned such schools as the *école d'architecture*, *école des mines*, *école des ponts et chaussées*, etc., all famous schools.

---

[1] Limitation of available time renders it impossible to deal with these.

CHAPTER XXXI.

CHAPTER XXXI.

The Technical High School of Charlottenburg, Berlin.

[G. H. KNIBBS.]

1. *Introduction.* -The Royal Technical High School of Berlin (*Königliche Technische Hochschule zu Berlin*), situated at Berlinerstrasse, Charlottenburg, a suburb of that city, not only has one of the finest buildings, but is also one of the most renowned Technical Universities in the world.

It was founded in 1879 by amalgamating two existing schools, viz., the *Bauakademie*, founded in 1799, and the *Gewerbeakademie*, founded in 1821.

Its present constitution was determined by the Statute of 28th July, 1882. It is governed by a rector, pro-rector, and senate. At the head of each division, or school, or department, is a president (*Vorsteher*). It has a very large number of ordinary and extraordinary professors, "Privatdozenten," and permanent assistants, etc., particulars in regard to which will be indicated later in order to give a sufficient indication of the magnitude of the institution.

The institution is immediately under the control of the Ministry for Ecclesiastical and Educational affairs (*Ministerium der geistlichen, Unterrichts-und Medizinal-Angelegenheiten*). Its expressed object is the furtherance of the education of those engaged in technical and industrial callings, either in the State service, or in that of the general community, and it has the further object of promoting, by research and otherwise, those branches of scientific and artistic knowledge which have any relation to technical and industrial callings.

2. *Departments of the Charlottenburg Technical High School.*—The school is divided into various departments (*Abteilungen*), as follows :—

I. Architecture (*Architektur*).
II. Civil Engineering (*Bau-Ingenieurwesen*).
III. Mechanical Engineering (*Maschinen-Ingenieurwesen*), which includes electro-technics (*Elektrotechnik*).
IV. Naval Architecture and Marine Engineering (*Schiff-und Schiffsmaschinen-Bau*).
V. Chemistry and Metallurgy (*Chemie und Hüttenkunde*).
VI. General Science—in particular Mathematics and Natural Sciences (*Allgemeine Wissenschaften, insbesondere für Mathematik und Naturwissenschaften*).

The Minister may increase the number of these divisions as necessity arises.

In connection with each division there are workshops, laboratories, cabinets of apparatus, museums, and experimental stations for the furtherance of special technical scientific knowledge appertaining thereto.

By way of extending or completing the instruction given in the lectures, there are practical exercises in the drawing-rooms, or in the laboratories, workshops, and experimental stations. Instruction is also given in the museums, cabinets of collections, and by means of field excursions whenever these are appropriate or necessary.

The instruction is arranged in courses of one year's duration, extending over four years. In certain cases only part of the year is set apart for instruction. There are periods of vacation from the 1st August to the 1st of October, and at Christmas and Easter for fourteen days.

The list of lectures and exercises is published six weeks at least before the beginning of the Courses. *The lectures and exercises in which the student desires to participate are at his own choice.* Definite programmes of study for each division are, however, drafted and recommended to students who intend to register for the various departments.

The various departments are not, however, regarded as self-contained and complete schools of training, and for this reason *students in each department are at liberty to attend classes in any other department.* And even in the courses recommended, a certain number of extra departmental classes are always included. Department VI (General Science) is in reality common to the other five departments, since it includes the more general and less technical subjects.

3. *Conditions of Entrance.*—All ordinary regular (matriculated) students must possess the Maturity Certificate (Reifezeugnis) of a Gymnasium, a Prussian Realgymnasium or "Realschule" of the first rank (*Realschule I Ordnung*) or of a Prussian "Oberrealschule" (or *Gewerbeschule* with nine-year course and two foreign languages) in order to be admitted; otherwise they must present other satisfactory evidence of sufficient previous training, and exceptional cases are subject to the Minister's approval. This is designed to ensure a thorough preliminary education.[1]

Educational institutions in other parts of Germany considered of equal grade are officially indicated.

In addition to matriculated students there are what are known as "*Hospitanten*" and "*Freihörer.*" The former do not possess the necessary qualifications to enter as regular students (*immatrikulirte Studirenden*), and their admission is restricted to special courses of lectures and laboratory work; the latter are admitted under special conditions.

Foreigners are admitted as matriculated students on satisfactory evidence of sufficient previous training. If the president of the Department is in doubt as to this, the question is remitted to the Senate.

Although each course extends over four years only, a considerable proportion of students continue their studies beyond this period, perhaps 12 or 13 %.

Students are admitted, as a rule, at the beginning of the academic year only, but if the courses allow also at the beginning of a semester. Although they must make a definite selection, a change later is not in any way debarred.

[1] As far back as 1898, out of 2,000 matriculated students, 54 % were Gymnasiasten, 39 % Realgymnasiasten, and only 7 % were from lower schools.

4. *Degrees.*—The Technical High School confers the degree of "*Diplom-Ingenieur*" (engineering diploma, and that of *Doktor-Ingenieur* (Doctor of Engineering). This right was conferred by the law (*Allerhöchste Erlass*) of 11th October, 1899, and is a recent decision after a lengthy consideration of the academic dignity and educational value from a liberal and general point of view of thorough training in any of the branches of higher technology.

5. *Fees.*—An entrance fee (*Aufnahme-Gebühr*) of 30 marks (30s.) is required of all students. The fee (*Honorar*) for ordinary courses is determined for each *Semester* (half-year) by the number of hours per week occupied by the instruction.

For regular students	-Lectures	4 marks
	Practical work	3 marks
For hospitanten or irregular students	—Lectures	5 marks
	Practical work	4 marks

If lectures are repeated a reduction of 40 per cent. is made in the case of students belonging to the German Empire.

For participation in practical work in the inorganic, organic, technical chemistry, metallurgical, electro-chemistry, and photo-chemical laboratories, the charge is 85 marks per half-year; for practice in physical chemistry, 15 marks; for practice in the laboratory for heat-technique, 20 marks; in the mechanical laboratory, 20, 30, or 50 marks; for practice in photography, 60 marks; the fee for practical work in the electro-technical laboratory is 50 marks for regular students, and 60 marks for *Hospitanten.* The fee for the geodetic "*Praktikum*" is 12 marks. For the course in helio-printing, etc., 3–6 marks is charged, according to whether it is of two or four weeks' duration. Those who undertake practical work in the chemical laboratories have also to pay 15 marks per half-year as security against damage.

The total fees per annum would run therefore from 300–350 marks (roughly, say, from £15 to £18).

Scholarships varying from about £20–£30 per annum, derived partly from State funds and partly from the towns, are annually awarded.

6. *Institutes and collections of various kinds in the Charlottenburg Technical High School.*—The institutes mentioned hereunder form part of the technical and material equipment of the Berlin Technical High School. In the department of Mechanical Engineering, there are an electro-technical laboratory and a chemical laboratory; in the department of Chemistry and Metallurgy there are the organic, inorganic, and metallurgical laboratories, the Mineralogical and Geological Institute, and the organic, photo-chemical, and technical chemistry laboratories. The department of General Science has associated with it the Physical Institute. Intimately connected with the Technical High School, also, is the magnificent establishment for experimental research in the provinces of mechanics and technology known as "*die königlich mechanisch-technische Versuchsanstalt*" at Gross Lichterfelde, about 5½ miles out of Berlin. This has departments for: -(1) The testing of metals; (2) testing of building materials; (3) of paper; and (4) of oils; and in itself has a staff of about 60 persons. At the Technical High School itself, there is also a mechanical workshop very finely fitted up.

The following collections of materials form also an important part of the splendid equipment of this renowned school:—

(1) Beuth Schinkel-Museum; (2) Collection of plaster casts; (3) Callenbach-collection; (4) Architectural Museum; (5) Collection of building materials; (6) Collection of building models; (7) Collection of geodetical instruments; (8) Collection for road illustrating engineering and rail-roads etc.; (9) Collection for water works; (10) Collection for iron structures in connection with civil engineering; (11) Collection illustrating railway construction; (12) Collection illustrating bridge structures; (13) Reuleaux' kinematic collection; (14) Collection for illustrating mechanical engineering in connection with railways, rolling-stock, etc.; (15) Collection for illustrating mechanical technology; (16) Engineering and mechanical collection; (17) Naval-architecture collection; (18) Photochemical collection; (19) Mineralogical museum; (20) Physical collection.

There is also a very fine library connected with the school.

7. *Teaching-staff and Students.*—In order to recognise the magnitude of the Berlin Technical High School, it may be mentioned that it had in the Winter Semester of 1901-2, 3,493 regular students, and 1,318 *Hospitanten*, etc.; in all, 4,811.

Its Professorial staff numbers as follows, for the different departments indicated in the table, viz.:—

Professorial staff, etc.

Denomination.	Departments. I.	II.	III.	IV.	V.	VI.	Totals.
Principal	1	1	1	1	1	1	6
Ordinary professors	8	9	11	4	7	8	47
Extraordinary professors	10	5	8	1	7	10	41
Privatdozenten	16	8	9	1	17	14	65
Permanent assistants	1	8	11	3	15	4	42
Constructing Engineers	......	......	6	2	......	......	8
Lecturers in foreign languages ...	......	......	......	......	......	3	3
Totals	36	31	46	12	47	40	212
Students	493	624	1,688	327	360	1	3,493

Each of the above departments embraces a very large number of courses, which are detailed in the several paragraphs next following.

8.

8. *Courses in Architecture.*—In the Department of Architecture there are 98 courses, including the following subjects, viz.:—

1st Year.—1, Descriptive geometry (I and II); 2, experimental physics; 3, experimental chemistry; 4, elementary geodesy; 5, practical exercises in surveying; 6, statics of building constructions, inclusive of fundamental mathematical theory; 7, theory of building construction; 8, ornament drawing; 9, ancient architecture, with exercises in detail; 10, review of the history of art, ancient, early Christian and Italian art of the Middle Ages and the early renaissance; 11, ancient art; 12, review of the history of art (II); Italian art in the high renaissance and Barocchio; 13, ancient Christian art and Italian art of the Middle Ages; 14, figure drawing from models, etc.; 15, landscape drawing from examples in pen, pencil, charcoal and Indian ink, and painting in water colors from models and from nature; 16, ornamental modelling; 17, figure modelling; 18, statics of engineering structures; 19, general mineralogy; 20, general geology; 21, geological practicum; 22, architectural technology; 23, foundations, bridge-building, retaining wall and piling, etc.; 24, fundamental elements of railway, road, and hydraulic construction; 25, plan-drawing; 26, history of the development of the principal ornamental forms; 27, interior decoration; 28, theory of building construction (higher course); 29, calculation and estimates of building; 30, materials of construction; 31, ornament drawing.

These 31 courses constitute those offered in the first year in architecture.

In the *second year* the subjects of instruction are:—

32, Ancient architecture (exercises); 33, history of the art of building in Western Asia and Greece; 34, history of Roman architecture; 35, simple structures, including agricultural buildings, etc.; 36, designing of buildings from given plans; 37, review of the history of art (I) (ancient, early Christian and Italian art of the Middle Ages and of the early renaissance); 38, ancient art; 39, review of the history of art (II) (Italian art in the time of the renaissance and of Barocchio); 40, ancient Christian art and Italian art of the Middle Ages; 41, ornamental modelling; 42, figure modelling; 43, drawing of figures from models, etc.; 44, landscape drawing from models in pen and ink, pencil, crayon and Indian ink, and painting in water colours from models and from nature; 45, fittings of a house and its furniture, ancient, mediæval, and early renaissance style; 46, the same, renaissance style, and those prevailing to the end of the 18th century.

These 15 courses, 32 to 46, constitute those offered during the second year.

In the *third year* the subjects treated of are:—

47, Prevention against accident (theory of industrial hygiene, technical part); 48, theory of industrial hygiene (social, political, chemical and physiological part); 49, statics of civil engineering (III); 50, fundamental elements of the theory of iron structures; 51, theory of building construction (higher course); 52, ventilation and heating; 53, history of the architecture of Western Asia and Greece; 54, history of Roman architecture; 55, drawing of ornaments in detail and studies of ornaments; 56, history of the development of the principal ornamental forms; 57, selected chapters from the history of ornament; 58, mediæval architecture and architectural designs in stone, brick and wood; 59, theory of the construction and form of mediæval architecture; 60, decorations of Gothic edifices; 61, wooden structures; 62, designs and details in mediæval forms, with special regard to brick buildings; 63, designs of structures according to definite schemes; 64, brick buildings; 65, the most important kinds of public and private buildings and city establishments; 66, architecture of the renaissance and designs of buildings; 67, designs (plans) of buildings, with all their details; 68, practice in architectural sketching; 69, architectural perspective drawing; 70, modelling and drawing from nature (life); 71, designing of figures from instructions; 72, drawing of figures from the living model; 73, Barocchi and "Rococo," and general history of style, decorative and industrial art; 74, history of the style of the 19th century (decoration, industrial art). These 28 courses, 47 to 74, are those offered in the third year.

In the *fourth year*, the subjects treated of are:—

75, Mechanisms (I); 76, mechanisms (II); 77, history of the architecture of Western Asia and Greece; 78, history of Roman architecture; 79, coloured decoration; 80, selected chapter from the domain of ornamentation; 81, designing of ornaments from instructions, free or improvised sketching; 82, mediæval architecture and designs in stone, brick and wood; 83, theory of the construction and form of mediæval architecture; 84, the decorations of Gothic structures; 85, wooden constructions; 86, designs and details in mediæval forms, with special regard to brick edifices; 87, brick buildings; 88, the most important kinds of public and private constructions and city buildings; 89, architecture of the renaissance and designs of buildings; 90, designs of buildings from instructions, etc.; 91, designs of buildings. with complete details; 92, practice in architectural sketching; 93, lighting and heating; 94, modelling and drawing from nature (life); 95, designing of figures according to given instructions; 96, drawing of figures from the living model; 97, Barocchi and "Rococo" (general history of style, decoration, industrial art); 98, history of style from the 19th century (decoration, industrial art). The above 24 courses, 75 to 98, are those offered for the fourth year in architectural.

9. *Courses in Civil Engineering.*—There are in all 65 courses belonging to this division, which are as follows:—

1st Year.—1, experimental physics; 2, physical exercises; 3, higher mathematics; 4, descriptive geometry (I) and (II); 5, mechanics; 6, elementary geodesy; 7, geodetical "Praktikum" (I); 8, exercises in surveying; 9, experimental chemistry; 10, introduction to experimental chemistry; 11, constructions in wood and stone; 12, elementary analysis and algebra; 13, higher mathematics; 14, descriptive geometry; 15, introduction to experimental chemistry. Courses 12 to 15 inclusive are for students entering at Easter, 1903.

The

The courses for the *second year* are :—

16, definite integrals and differential equations; 17, mechanics II; 18, selected chapters from mechanics and its history: 19, graphical statics; 20, plan-drawing; 21, geodetical "*Praktikum*"; 22, higher geodesy; 23, general mineralogy; 24, general geology; 25, geological "*Praktikum*"; 26, mechanical technology; 27, technology of construction; 28, theory of the examination of materials, with practical exercises; 29, building-construction in wood and stone; 30, machines I, and summary of the elements of machines; 31, machines, power, work, in particular machine-construction; 32, encyclopædic electro-technics, including electro-telegraphy, with experiments; 33, the theory of architectonic form; 34, metallurgy of iron; 35, the general theory of political and social economy; 36, introduction to jurisprudence and political science; 37, higher mathematics; 38, descriptive geometry II. The courses 16 to 36, 21 in all, are those offered in the second year; 37 and 38 are for new students entering in Easter, 1902.

In the *third year* the courses are :—

39, statics of building-contruction; 40, exercises in the statics of building-construction; 41, stone and wooden bridges, retaining-wall, etc.; 42, roads and street railways; 43, railway construction I, the fundamental elements thereof; 44, the main features of the establishment of railway stations; 45, railway-buildings and other constructions for rolling-stock, etc.; 46, foundations; 47, practical hydraulics; 48, flood-gates, locks, and canal construction; 49, construction of banks and weirs; 50, iron constructions in connection with civil-engineering; 51, railway engines (locomotives, carriages, and mechanical arrangements); 52, theory of potential; 53, calculus of variations. The courses 39 to 53 are those offered in the third year.

In the *fourth year* the subjects are :—

54, the constructive works in railways II (including tunnelling and the establishment of large railway stations); 55, railway management, including safety appliances (exercises in the designing of tables); 56, iron bridges and difficult iron constructions; 57, movable bridges; 58, sea and harbour works; 59, sea and harbour works, with exercises in design; 60, canalisation, etc., including agricultural technique; 61, the water-supply of cities; 62, drainage of cities; 63, electric railways; 64, sketch of naval architecture; 65, theory of functions. These 12 courses, 54 to 65, conclude those offered in civil-engineering.

10. *Courses in Mechanical Engineering.*—This division includes 138 courses, which are as follows :—

1, Experimental physics; 2, exercises in the physical laboratory, physical measurements; 3, higher mathematics; 4, mechanics I; 5, descriptive geometry; 6, mechanical technology; 7, introduction to the construction of engines; 8, introduction to experimental chemistry; 9, the general theory of political economy I and II.

The subjects of the *second* year are :—

10, mechanics; 11, the elements of machines; 12, thermo-dynamics; 13, theory of materials; 14, graphical statics; 15, lifting-machines; 16, exercises in the mechanical laboratory I (half-year course); 17, mechanical technology; 18, political economy; 19, commercial transactions and commercial policy.

The subjects of the *third year* are :—

20, electro-mechanics; 21, design of machinery for lifting; 22, construction of steam-engines; 23, hydraulic turbines, etc.; 24, exercises in mechanical laboratory II; 25, power-engines; 26, elements of ordinary and underground engineering; 27, boilers; 28, statics of building-construction; 29, financial science; 30, banking and exchange business; 31, exercises with regard to banking and commercial business.

In the *fourth year* the curriculum is divided into general mechanical engineering, railway-engine construction, and electro-technics. The subjects taught in connection with *general mechanical engineering* are :—

32, Design of water-power engines (half-year course); 33, buildings necessary for industrial engineering works; 34, buildings necessary for communal mechanical works; 35, machine construction; 36, water-power engines; 37, designs for water-power engines and boilers; 38, machine tools; 39, exercises in the mechanical laboratory III; 40, technique of the production of cold; 41, theory, construction and application of freezing-machines; 42, exercises in the electro-technical laboratory; 43, construction of dynamos and transformers.

The courses in the section for *railway-engine construction* are :—

44, construction of railway engines, locomotives, carriages, and general characteristics of the superstructure; 45, railway management, railway despatch service, systems of signalling; 46, working material, installation and material for workshops [33, arrangement of buildings for industrial machinery; 34, arrangement of building for communal mechanical works][1]; 47, the iron constructions of the civil-engineer; [38, machine tools]; 48, iron bridges and difficult engineering structures; 49, electro-telegraphy [39, exercises in the mechanical laboratory; 42, exercises in the electro-technical laboratory]; 50, railway arrangements and working, inclusive of safety appliances; 51, railway buildings, stations, and other constructions necessary in railway working; 52, transport [43, construction of dynamos and transformers].

The courses in *electrotechnics* are as hereunder :—

[42, Exercises in the electro-technical laboratory]; 53, selected chapters from electro-mechanics; [43, construction of dynamos and transformers; 39, exercises in the mechanical laboratory]; 54, design of electric installations; 55, encyclopædic treatment of electro-technics, including experimental electro-telegraphy; 56, electric measurements; 57, technique of lighting, and installations for that purpose; 58, technique of alternating currents; 59, transmission of electric energy;

[1] The square brackets, [ ], denote that the course occurs in an earlier section: it is not therefore counted twice.

energy; 60, transmission of alternating currents through long distances; 61, electric railways; 62, selected chapters from electro-technics; 63, electro-technical calculations (resistance, conductivity, and machinery); 64, alternating current converter [49, electro-telegraphy]; 65, working technique for electrical works and commercial enterprises; 67, the physical foundations of electro-technics, I and II, part I, in summer; 68, elements of electro-chemistry; 69, general electro-chemistry; 70, applied electro-chemistry; 71, magnetic and electric units, and modes of measurements; 72, electro-magnetism and induction; 73, theory of galvanism; 74, introduction to the theory of potential; 75, outlines of the theory of potential, and its application in the theory of electricity; 76, on electric oscillations.

The following courses are distributed in years I to IV for all specialisations in the subject of mechanical engineering:—

77, Readings of French authors; 78, English for beginners and for advanced students; 79, Russian, four courses, progressive; 80, prevention of accident, industrial hygiene, technical part; 81, industrial hygiene, social, political, chemical, and physiological part; 82, special mechanical technology; 83, ventilation and heating; 84, exercises in the laboratory for heat technique; 85, exercises in the statics of building construction; 86, applied mathematics; 87, kinematic geometry, and theoretical kinematics; 88, the driving of machinery, applications of kinematics; 89, changes in the structure of metals; 90, foundations, bridges, retaining walls, etc.; 91, elements of railway, road, and hydraulic constructions; 92, railway construction I; 93, foundations; 94, practical hydraulics; 95, drainage and canals; 96, streams and weirs; 97, water supply and watering drainage, etc., of a city; 98, movable bridges; 99, sketch of naval architecture; 100, marine boilers I and II; 102, auxiliary engines on ships; 103, metallurgy I and II; 104, metallurgy; 105, the equipment and working of a foundry; 106, chemical technology I; 107, chemical technical information as to organic substances; 108, definite integrals and differential equations; 109, theory of curves and surfaces in space; 110, introduction to vector analysis; 111, descriptive geometry, I and II; 112, selected chapters in analytical mechanics; 113, mathematical physics; 114, mathematical physics; 115, elementary geodesy; 116, practical exercises in surveying; 117, general mineralogy; 118, general geology; 119, theory of potential; 120, calculus of variations; 121, theory of functions; 122, mechanical theory of heat; 123, physical measurements and measuring instruments; 124, sketch of technique of gas analysis; 125, hygiene for architects and engineers; 126, *political questions of the day*; 127, *history of socialism*; 128, *general political economy*; 129, elements of financial science; 130, industrial law; 131, commercial law; 132, patent, trade-mark and similar law; 133, building laws; 134, photographic and heliographic practice; 135, introduction to jurisprudence and State science, with discussion of interesting cases; 136, industrial protection, laws concerning patents, trade-marks, etc.; 137, administrative law; 138, citizens law-book, selected chapters.

It will be seen from the above that the range of lectures which may be attended by a mechanical engineer are very large indeed.

11. *Courses in Naval Architecture and Marine Engineering.*—The total number of courses in the four years for naval architects and marine engineers, etc., is 41, the details being as follow:—

First Year. 1, Experimental physics; 2, exercises in the physical laboratory, chiefly physical measurements; 3, higher mathematics; 4, mechanics; 5, descriptive geometry I and II; 6, engineering; 7, theory of building construction; 8, freehand drawing (decorations of the bow and stern of a vessel); 9, mechanical technology; 10, experimental chemistry; 11, introduction to experimental chemistry; 12, drawing and designing of ships.

In the *second year* the courses are:—

13, Mechanics; 14, elements of machines; 15, the mechanics of heat; 16, lifting machines (winches, cranes, etc.); 17, metallurgy I and II; 18, theory of ships I and II; 19, drawing and designing of ships I; 20 instruction in designing of ships; 21, practical naval architecture; 22, marine boilers.

In the *third year* the courses are:—

23, Construction of steam-engines; 24, technique of the refrigerating plant; 25, equipments of men-of-war; 26, theory of ships III; 27, designs of ships II; 28, instruction in designing of vessels II; 29, practical naval architecture II; 30, flushing and similar arrangements, water-tight compartments; 31, marine boilers II; 32, designing of marine boilers; 33, marine engines.

In the *fourth year* the courses are:—

34, Construction of men-of-war; 35, designing of ships III; 36, marine engines; 37, designing of marine engines, system of pipes; 38, auxiliary machinery; 39, machine tools; 40, exercises in the electro-technical laboratory (for marine engineers); 41, encyclopædic electro-technics with experiments.

12. *Courses in Technical Chemistry.*—The total number of courses in the four years for technical chemists is 58, the details being as follows:—

First Year. 1, Elements of the differential and integral calculusand analytical geometry; 2 elements of mechanics; 3, elements of descriptive geometry, with exercises; 4, experimental physics; 5, experimental chemistry I (metalloids); 6, experimental chemistry II (metals); 7, crystallography and mineralogy; 8, "*Praktikum*" for crystallographical mineralogy; 9, mechanical technology I; 10, machines I, with exercise in machine drawing; 11, machines II, with exercises in machine drawing; 12, general botany; 13, special botany; 14, microscopy: 15, exercises in the physical laboratory (physical measurements); 16, practical work in the inorganic laboratory.

The courses in the *second year* are as follows:—

17, Organic chemistry; 18, chemical technology I; 19, analytical chemistry; 20, organic chemistry I; 21, theory of building construction, with exercises; 22, spectrum analysis; 23, practical work in the inorganic laboratory; 24, metallurgy.

The

The following are the *third year* courses, viz. :—

25, Agricultural industry ; 26, chemical technology II ; 27, glass ceramics and apparatus connected with their manufacture ; 28, general geology ; 29, geological "*Praktikum*"; 30, microscopic-crystallographical exercises ; 31, chemistry of foodstuffs ; 32, history of chemistry ; 33, general photography ; 34, introduction to photographic optics ; , 35 photo-chemistry and photo-mechanical processes ; 36, photographical exercises in ordinary processes ; 37, practical work in the photo-chemical labortory (special for such students who desire to devote themselves to photo-chemistry) ; 38, types of construction of photographic optical instruments ; 39, *colloquium* on subjects from organic chemistry ; 40, organic chemistry II ; 41, practical work in the organic laboratory ; 42, microscopy II.

In the *fourth year* the courses are as follows :—

43, Practical work in the technico-chemical laboratory ; 44, dyes, bleaching, dyeing, printing on materials, etc. ; 45, investigation of sugars ; 46, precautions against accidents (industrial hygiene, technical part) ; 47, industrial hygiene (social political, chemical and physiological part) ; 48, sketch of the technique of gas analysis ; 49, practical work in the electro-chemical laboratory ; 50, general electro-chemistry ; 51, applied electro-chemistry ; 52, physical chemistry ; 53, thermo-chemistry ; 54, physico-chemical exercises ; 55, examination of vegetable and animal fats, oils and wax ; 56, examination of mineral oils and other naphtha products ; 57, exercises in heliographical work ; 58, "*Colloquium*" on subjects from organic chemistry.

13. *Courses in Metallurgical Engineering.*—The total number of courses in the four years for Metallurgical engineers is 56, the details of which are as follows :—

First Year. 1, Elements of the differential and integral calculus and of analytical geometry ; 2, elements of mechanics ; 3, elements of descriptive geometry with exercises ; 4, experimental physics ; 5, exercises in the physical laboratory (physical measurements) ; 6, experimental chemistry (metalloids) ; 7, experimental chemistry (metals) ; 8, crystallography and mineralogy ; 9, crystallographical-mineralogical *Praktikum ;* 10, mechanical technology ; 11, introduction to engineering ; 12, practical work in the inorganic laboratory.

Second Year. 13, Organic chemistry I ; 14, chemical technology I ; 15, analytical chemistry ; 16, spectrum analysis ; 17, practical work in the inorganic laboratory ; 18, general geology ; 19, geological *Praktikum,* 20, metallurgy ; 21, preparatory operations ; general docimacy ; 23, theory of building construction with exercises ; 24, mechanical technology II ; 25, machines, with exercises in machine-drawing ; 26, mechanics of heat ; 27, encyclopædic electro-technics.

Third Year : 28, Chemical technology II ; 29, glass, ceramics, and allied apparatus ; 30, microscopic-crystallographical exercises ; 31, general docimacy ; 32, machines, with exercises in mechanical drawing ; 33, practical work in the inorganic laboratory ; 34, elements of ordinary and underground engineering, with estimation of cost ; 35, arrangement and management of a foundry ; 36, practical work in the metallurgical laboratory ; 37, history of chemistry ; 38, lifting machinery (winches, cranes, etc.) ; 39, exercises in the mechanical laboratory I ; 40, theory of materials, with exercises in the mechanico-technical experimental station ; 41, theory of electrical measurements.

Fourth Year. 42, Practical work in the metallurgical laboratory ; 43, sketch of the technique of gas analysis ; 44, general electro-chemistry ; 45, applied electro-chemistry ; 46, exercises in heliographic processes ; 47, prevention of accident (industrial hygiene, technical part) ; 48, industrial hygiene (social political, chemical and physiological part) ; 49, physical chemistry ; 50, thermo-chemistry ; 51, physico-chemical exercises ; 52, machinery (pumps, blast-engines) ; 53, exercises in the electro-technical laboratory ; 54, exercises in the mechanical laboratory ; 55, construction and management of factories ; 56, plans of buildings, etc., for industrial mechanical contrivances.

14. *Practical Exercises in the Physical Laboratory.*—It will throw some light on the nature of the preceding courses if a reference is made to the practical exercises carried out in connection with the work. These are very systematically and completely developed, as the following series will shew :—

Measurement of Thickness.

(1) With screw micrometer-gauges ; (2) the lever spherometer ; (3) interference spherometer ; (4) Wild's spherometer ; (5) Zeiss's depth calipers ; (6) the microscope.

Measurement of Length.

(7) With the Kathetometer ; (8) dividing engine ; (9) microscope ; (10) determination of scale-divisions by Bunsen's method ; (11) comparisons of various barometers ; (12) barometrical hypsometry ; (13) determination of the acceleration of gravity by the pendulum ; (14) Zero point of a balance ; (15) its sensitiveness ; (16) proportion of the beams ; (17) absolute weight of a body, by Gauss's and substitution methods.

Determination of the Specific Gravity (Density) of Solid Bodies.

(18) By weighing and the determination of volume ; (19) weighing in air and water ; (20) with a Jolly's balance ; (21) with a pycnometer ; (22) by the oscillation method.

Determination of the Specific Gravity (Density) of Fluids.

(23) With the areometer ; (24) with the pycnometer ; (25) with Mohr's balance.

The density of gases and vapours.

(26) Determination of the specific gravity (density) of the air ; (27) determination of the specific gravity (density) of gas by Bunsen's method ; (28) determination of the vapour densities by Dumas' method ; (29) determination of vapour densities by V Meyer's method.

Determination

Determination of humidity.

(30) By Regnault's method; (31) with Fuess's hygrometer; (32) with August's psychrometer.

Determination of the radius of a capillary.

(33) By weighing with quicksilver; (34) by means of the microscope; (35) determination of the capillary constants by the height to which the fluid rises.

Determination of the modulus of elasticity.

(36) Of a wire by its elongation; (37) of a bar by its bending; (38) the torsion modulus of a wire.

(39) Determination of the velocity of sound by Kundt's method in solid bodies; (40) through gases; (41) the velocity of sound by interference experiments; (42) comparison of the number of vibrations of two tones by means of the monochord.

(43) Measurement of angles by means of the reflecting sextant; (44) the measurement of the angles of crystals by means of the goniometer.

Determination of refractive indices.

(45) Of a glass prism; (46) and of a liquid, by the method of the minimal deviation; (47) Abbe's refractometer; (48) determination of wave lengths; (49) determination of the radius of a lens by measurement; (50) determination of the radius of a lens by reflection with the ophthalmometer.

Determination of the Focal Distances of Lenses.

(51) By measuring the distances of the source of light and image; (52) by means of the telescope; (53) by Bessel's method; (54) magnifying power of a telescope; (55) its field; (56) magnifying power of a microscope.

Spectrum Analysis.

(57) Metal spectra; (58) spectral analyses of mixtures of salts; (59) spectra of gases; (60) absorption spectra.

(61) *Photometry.*

Determination of the Optical Rotation.

(62) By means of Mitscherlich's apparatus; (63) by the half-shadow apparatus of Lippich; (64) by means of Wild's polar strobometer; (65) by means of the saccharimeter; (66) determination of the sugar content of a solution.

Thermometry.

(67) Zero and boiling points of a thermometer; (68) calibration of a thermometer; (69) comparison of mercury thermometers with one another and with the air-thermometer; (70) boiling points of fluids.

Determination of Co-efficients of Thermal Expansion.

(71) Of bars by measurements of length; (72) of air by means of the air-thermometer; (73) determination of specific heats by the method of mixing; (74) by Bunsen's ice-calorimeter; (75) determination of the emissivity of various surfaces by means of the thermopile; (76) determination of the absorption of a glass plate.

Determination of the Electric Resistance of Metals.

(77) By the substitution method; (78) by the differential multiplier; (79) by a Wheatstone's bridge; (80) by means of a universal rheostat; (81) setting up of a reflector galvanometer; (82) measurement of a very small resistance; (83) of a very large resistance; (84) resistance—measurements by the damping of an oscillating magnet; (85) specific resistance of metals; (86) temperature—co-efficient of metal wires; (87) calibration of a thermo-element.

Conductivity of an Electrolyte.

(88) By a constant current—Paalzow's method; (89) by means of an alternating current and telephone; (90) by means of an alternating current and a vibration galvanometer; (91) temperture-co-efficient of an electrolyte; (92) resistance of a galvanometer, by Thomson's method; (93) resistance of an element, by Mance's method; (94) resistance of an element with alternating current and telephone.

Comparison of Electromotive Forces.

(95) By du Bois-Reymond's compensation method; (96) by means of compensation apparatus; (97) by the reflecting galvanometer; (98) by the torsion galvanometer; (99) by means of the electrometer; (100) by means of a condenser and ballistic galvanometer.

(101) Determination of the reduction-factors of a tangent galvanometer with the silver voltameter; (102) determination of the reduction-factors of an ampèremeter with the water voltameter; (103) determination of the dielectric constants of fluids, by Nernst's method.

(104) Determination of the co-efficient of selt-induction; (105) inclinatorium (dip instrument); (106) determination of the dip by means of the earth inductor; (107) horizontal intensity of the earth's magnetism; (108) comparison of magnetic moments by the magnetic meter method.

(109) Investigation of the magnetic properties of various kinds of iron with du Bois balance; (110) measurement of fields of high potential by means of the induction-slide; (111) by the resistance of a bismuth coil; (112) determination of Verdet's constant for various substances.

15. *Practical Work in the Electro-technical Laboratory.*—A further example will be taken illustrating the character of the work done in the Berlin Technical High School, viz., the series of practical exercises in the electro-technical laboratory. With the exception of Monday and Thursday, this laboratory is opened from 8 to 5 daily. The discipline of the establishment is maintained by publishing a series of rules, minor offences against which are punished by a small fine. Fines are applied in the interests of the laboratory itself.

There

There are four courses of exercises, covering a very wide range, the details of which are as hereunder—

1st. Course—

(A) *Applications of Ohm's, Kirchhoff's and Joule's Laws.*

1, Measurements of resistance, with a Wheatstone bridge; 2 with a differential galvanometer; 3, comparison of electrical energy with the equivalent quantity of heat.

(B) *Standardising.*

4. Standardising of ampère meters, voltmeters; ampère-hours; 7, watt-hours.

(C) *Battery Measurements.*

8. Comparison of electro-motive forces by Bosscha's method; 9, by Poggendorff's method; 10, continuous investigation of working batteries by Fechner's method.

(D) *Measurements of Thermopiles.*

11, Investigation of thermopiles, of different kinds.

(E) *Accumulator measurements.*

12, The charging of accumulators (currents of constant strength); current from same.

(F) *Photometry.*

13, Photometry of gas lamps; 14, of incandescent lamps; 15, of arc lamps.

(G) *Electro-motor measurements.*

16, Investigation of electro-motor models connected up with a battery.

(H) *Machine Measurements.*

17, Determination of the "characteristic" of a series-wound machine; 18, of a shunt-wound machine; 19, and of a compound machine; 20, investigation of a shunt-wound machine; 21, determination electrically of the brake h.p. of a shunt-wound electro-motor; 22, determination of the "characteristic" of an alternating current machine; 23, determination of the transformation-ratio of a transformer; 24, determination of the "characteristic" of a "Drehstrommaschine."

Second Course—

(J) *Special mesurements of resistance.*

25, Insulation measurements, with conductors, machines, transformers, and condensers; 26, testing the insulation of any electric installation; 27, determination of faults in conductors; 28, measurements of temperature-coefficients; 29, measurement of very small resistances by Thomson's method; 30, measurements of the resistance of fluids with an alternating current.

(K) *Standardising with compensation-apparatus.*

31, Standardising volt and ampèremeters.

(L) *Magnetic measurements.*

Ballistic method: 32, standardising of ballistic galvanometers; 33, determination of the magnetisation curves of iron rings, etc.; 34, deviation method, 34, determination of the horizontal component of the earth's magnetism; 35, of the curve of magnetism, the determination of hysteresis; 36, investigation of test pieces, with technical apparatus.

(M) *Special photometry.*

37, Photometry of continuous current arc-lamps with and without globes; 38, photometry of the alternating current arc-lamps; 39, photometry of incandescent lamps with various voltages; 40, photometric comparison and estimate of cost of various sources of light.

(N) *Measurements of continuous current machines and motors.*

41, Measurements of losses; 42, distribution of electro-motive force, about a collector with open and closed circuits; 43, mechanical efficiency of a shunt-wound electro-motor; 44, investigation of a transformer; 45, investigation of a series wound electro-motor with constant voltage; 46, investigation of the transmission of main current; 47, investigation and calculations of a dynamo—(a) the armature reaction by means of the "magnetic characteristic;" (b) determination of the armature losses by Kapp's method; (c) mechanical brake; (d) computational proof of the efficiency by means of the construction data.

Third Course—

(O) *Measurements of induction-coefficients.*

48, Measurements and coefficients of self-induction; 49, of the coefficients of reciprocal induction.

(P) *Measurements of condensers.*

50, Charging and discharging of a condenser; 51, determination of the capacity of a condenser.

(Q) *Electrometer measurement.*

52, Standardising an electrometer by various methods.

(R) *Comparative standardising of alternating-current instrument.*

53, Standardising a dynamometer with continuous and alternating current; 54, standardising a voltmeter for 1,000 volts with an electrometer; 55, investigation of phase-measurement; 56, of a recording instrument; 57, of the influence of a vortical current on the registrations of a wattmeter; 58, investigation of the influence of self-induction in a partial cycle on the registration of a wattmeter; 59, testing the relation of technical alternating-current instruments with varying potentials and current curves.

(S)

(S) Measurements of alternating current machines.

60, investigation of an alternating current circuit of large self-induction without iron (fundamental law of alternating current); 61 investigation of an alternating current circuit with iron (work of hysteresis and Faucalt currents); 62, investigation and calculation of an alternating current machine—(a), determination of the magnetic characteristic with empty circuit, load without induction, and load with induction; (b), determination of the potential characteristic with load without induction, and load with induction; (c) computational proofs from the data of construction; 63 determination of the periodic cycle of electro-motive force of an alternating current machine; 64, alternating current machines in parallel.

(T) Investigation of transformers for alternating currents.

65, investigation of a transformer without iron; 66, investigation of a transformer with open magnetic circuits *("Igel-Transformator")*; 67, investigation of a transformer with closed magnetic circuits *("Mantel-Transformator")*; 68, transformation from 100 to 1,000 volts and back to 100 for transmission of energy; 69, investigation and computation of a "Kern-transformator."

(U) Measurements with a condenser in an alternating current curcuit.

70, relation of a condenser—(a) in parallel with a transformer; (b) in series with a transformer; 71, the condenser in the working of an installation for the transmission of electric energy with transformers.

(V) Measurements with alternating current motors.

72, investigation of synchronous alternating current motor with various periods and curves of potential; 73, investigation of an asynchronous alternating current motor.

(W)

74, measurement of the performance of a rotating current machine; 75, investigation of a rotating current motor with various periods and curves of potential—(a) mechanical brakes; (b) numerical calculations, etc., from data of construction; 76, comparative investigation of a rotating current motor as three-phase and single-phase motor.

Fourth Course—

77, Influence of the field on the rotation frequency and current strength and the armature of a continuous current electro-motor; 78, influence of the arrangement of the brushes upon the current from a continuous current machine; 79, brake of a electro-motor; 80, investigation of the mode of action of fluid resistances in connection with alternating current motors; 81, influence of variations of phase on the distribution of alternating current machines; 82, measurement of the distribution in transformers; 83, determination of the transformation ratio of a transformer with various loads; 84, investigation of a rotating transformer for one, two, and three phase alternating current; 85, influence of division in the armature winding of an alternating current machine on the form of the potential curve; 86, investigation of a rotating current continuous current transformer; 87, investigation of a rotating current transformer with a non-uniform load for the three phases; 88, photometry of arc-lamps with the included arc-light.

16. *Student Journeys and Excursions.*—The professors and Dozenten, with the assistance of the State, make, from time to time, educational journeys. In the 1903-Calendar, two professors visited France; one, Westphalia, the Rhine, Luxemburg, and Lorraine; one, the German, Swiss, and Austrian photo-chemical laboratories and teaching institutions; one visited Leyden to continue an experimental investigation; two visited Dusseldorf, and one Glasgow and Dusseldorf. Among journeys by students may be mentioned twenty-two who visited medæval architecture in Munich, Verona, Ravenna, Rome, Frascati, Tivoli, Naples, Pompei, Paestum, Salerno, Amalfi, Sorrento, Perugia, Assisi, Florence, Pisa, Siena, Milan, Lucerne, Nürnburg. Great numbers make minor journeys for the same purpose.

The industrial and technical works of the whole of Germany assist by affording opportunity for students to see their works, and not only so, but a large number take students of the technical high schools into their establishments, giving them a moderate rate of pay to acquire practical experience; and they do this, not as a source of profit, but with the intention of aiding the educational authorities in reinforcing the industrial power of the German Empire. With a view of shewing the type of establishments visited by students, we may take at random one of the student sections. Students visited the Central City Pumping Station, the two water-works of Berlin, the electrical works of Berlin, the workshops of a large number of private firms, the factory for the manufacture of patent linoleum, jute spinning and weaving works, a number of engineering shops, the gas-works of the Imperial Continental Gas Association, steel works—among which may be mentioned the great works of Krupp—works for the manufacture of boilers, steam engines, etc., electric power-house stations, the telegraph and telephone offices, breweries, with their refrigerating apparatus, factories for insulating material, velvet-weaving, carpet-weaving, and other weaving establishments, and a great many others too numerous to mention.

17. *Concluding Remarks.*—The special feature of such schools as the Technical High School is the freedom to take such courses as the student himself desires. The different schools and their programmes are recommendations to students rather than peremptory directions; consequently the graduates follow such courses as they consider will best advance their interests or accord with their natural aptitudes and powers. In some cases—engineering for example—the issue of the diploma depends upon proof of practical work in some branch of engineering being undertaken, either during the currency of the period of studies, or subsequently. The system seems to lead to excellent results, both in so far as practical power and thoroughly scientific knowledge are concerned.

CHAPTER XXXII.

CHAPTER XXXII.

The Technical High Schools of Germany.

[G. H KNIBBS.]

1. *Introductory.*—The previous chapter gives an account of perhaps the largest and most eminent technical high school in Germany; but all the technical high schools seen by the Commissioners were magnificent institutions, and were splendidly staffed and equipped. In every school seen there had been recent important additions, and though the laboratories in individual schools indicate some degree of special development, the provision made for electro-technics was characteristically perfect in every institution seen. The technical high school of Karlsruhe was more than ordinarily well-equipped for electro-technics and mechanical engineering, and in respect of these features it is probably one of the best equipped technical universities in Europe.

The technical high school of *Darmstadt* had been recently enlarged and was specially well-equipped for electro-technics. The cabinet of the electro-technical department was supplied with a large number of pieces of new apparatus. The hydraulic equipment was also remarkably good, and developed on a large scale.

The technical high school of *Aachen*, which has departments in architecture, civil engineering, mechanical engineering, mining chemistry and electro-chemistry, and general science, had recently also been greatly developed. Its buildings are extensive and have recently been enlarged.

At the technical high school at *Hanover*, it may be mentioned that the spectrum analysis apparatus of Professor Runge was seen. The equipment was elaborate throughout, and all bore testimony to the possibility of original research of the first order being undertaken.

Technical education in *Hamburg* has been referred to in a previous chapter.

Taking the technical high schools of Germany as a whole, one can describe their equipment only as lavish. The teaching-staffs are very large; the quality of the teaching is of the highest order; the leading men are large contributors to the progress of science, and the amount of original contributions made thereto from these institutions is very large. There is a high degree of specialism in the teaching.

Although not absolutely identical, the German technical high schools are very similarly organised. A comparative study of them all would have been well worth undertaking, but time will not permit.

It was the original intention of the Commissioner to treat of these institutions comprehensively, but it must now suffice to give a fairly complete sketch of one of them, and for this purpose the Technical High School of Munich has been taken.

In order that the teaching-power of these institutions may be properly grasped, an outline of the completeness of the teaching personnel is given. The laboratory equipment, the detailed courses, as well as the programme of studies, are sketched with sufficient completeness to disclose the excellence of higher technical education in Germany.

2. *Teaching Staff of the Technical High School of Munich.*—The Teaching-staff in the *General Division* of the Technical High School consists of the following professors and lecturers:—

One Professor of Æsthetics and of the History of Art; one Professor of Descriptive Geometry and Kinematics; one Professor of National Economy, Statistics and Political Economy and Bavarian Political Law; two Professors of Mathematics; one Professor of Geography; one Professor of Experimental Physics; one Professor of History; one Extraordinary Professor of Technical Physics; one Extraordinary Professor of German History of Universal and German Literature; one Honorary Professor of Physics; one Honorary Professor of Geography; two Professors of Institutions for Military Education; one Honorary Professor for the Romanic Languages; two Privat-Dozent in the History of Art; one Privat-Dozent in Physics; one Privat-Dozent in Physics and Meteorology; one Privat-Dozent in the History of Descriptive Natural Science; one Gymnasial Professor; one Privat-Dozent of Applied and Pure Mathematics. Total, 20.

In the *Civil Engineering Division* there are the following:—

Three Professors of Engineering Science; one Professor of Geodesy and Topography; one Privat-Dozent in Geodesy and Engineering Science. Total, 5.

In the *Architectural Division* there are—

Three Professors of Architecture; one Professor of the Theory of Architectural Form, Perspective and Interior Decoration; one Professor of Civil Engineering Construction; one Professor of Plastics; one Extraordinary Professor of the Theory of Construction and of Materials of Construction; one Extraordinary Professor of Freehand Drawing and Water-colour Drawing; one Extraordinary Professor for Agricultural Architecture and Engineering. Total, 9.

For

For the *Mechanical Engineering Division* the teaching-staff consists of:—

One Professor of Mechanical Technology and Mechanical Construction; one Professor of Applied Physics; one Professor of Theory of Engineering Construction; three Professors of Machine-construction; one Professor of Mechanics; two Professors of Electro-technics; one Professor of Applied Thermodynamics; one Extraordinary Professor of Mechanical Construction. Total, 11.

The teaching-staff of the *Chemical Division* is as follows:—

One Professor of Mineralogy and Geology; one Professor of Chemical Technology with Metallurgy and Mining; one Professor of the Chemistry of Fermentation; one Professor of Analytical and Applied Chemistry; one Professor of Inorganic Chemistry; one Honorary Professor for Geology and Palæontology; two Privat-Dozenten in General Chemistry; one Privat-Dozent in Electro-chemistry; one Privat-Dozent in Hygiene, Extraordinary Professor in the University: one Privat-Dozent in Geology and Palæontology; one Privat-Dozent in Mineralogy and Geology; one Privat-Dozent in Physical and Inorganic Chemistry. Total, 13.

The teaching-staff of the *Agricultural Division* consists of the following:—

Two Professors of Agriculture; one Professor of Agricultural Chemistry; one Extraordinary Professor of Agriculture; one Honorary Professor for special Botany; one Professor for Agricultural Chemistry, specially the Theory of Nutrition applied to Animals and Dairying. Total, 5.

The teachers of the *General Division* are:—

One Gymnasial Professor for French Language and Literature; one Privat-Dozent (at the University) for English Language and Literature; one for Italian Language and Literature. Total, 3.

Of the Civil Engineering Division, one for Technical, Plan, Chart, and Cadastral Drawing. Total, 1.

Assistants. The "Assistants" of the *General Division* are:—

Three in the Physical Institute; four for Higher Mathematics; three for Descriptive Geometry; one for Technical Physics. Total, 11.

In the *Civil Engineering Division* they are:—

Three for Engineering Science; and three for the Geodetical Institution. Total, 6.

The "Assistants" of the *Architectural Division* are:—

One for Building Design. one for the theory of Building Construction; one for the Theory of Architectural Forms, Shadow Construction and Perspective; one for Higher Architecture; and one occasional assistant for Architectural Drawing. Total, 5.

In the *Mechanical Engineering Division* the "Assistants" are:—

One in the Laboratory for Technical Mechanics; four for Mechanical Construction; three in the Laboratory for Electro-technics; one for Theory of Engineering Construction; one sub-Assistant for Engineering; two sub-Assistants in the Laboratory for Electro-technics; two Volunteer Assistants in the Laboratory for Electro-technics; one Assistant for Electro-technics, especially for Practice in Electro-technical Construction; one for Technical Mechanics. Total, 16.

In the *Chemical Division* the "Assistants" are:—

Five in the Chemical Laboratory; one in the Electro-chemical Laboratory; one for Mineralogy and Geology; one in the Laboratory for Technical Chemistry; one in the Laboratory for the Chemistry of Fermentation; one for Inorganic Chemistry. Total, 10.

In the *Agricultural Livision* the "Assistants" are:—

Three in the Agricultural Central Experimental Station; one in the Laboratory for Chemical Agriculture; one in the Agricultural Laboratory and Experimental Field. Total, 5.

Outside the teaching staff of the Technical High School there are the following, who assist in the courses of instruction, viz.:—

One Professor of Physiology in the University; one Professor of Botany in the University; one Professor of Botany in the Veterinary High School; one Professor of Epidemics in the Veterinary High School; one Professor of the Veterinary High School in Comparative Anatomy, Embryology, and the History of the Development of Domestic Mammals; one "Direketions assessor" of the State Railways for Electro-technics; Agricultural Engineer (of the Hydrotechnical Bureau in the Royal State-Ministerium for the Interior) for Agricultural Amelioration; the Director of the Royal Moor Cultivation Institution, for Moor Cultivation; Privat-dozent in the University ("Observator" for the Commission for International Geodesy) for Calculation of Probabilities and Spherical and Theoretical Astronomy. Total, 9. Grand total, 108.

Incidentally it may be remarked that it is a very usual practice for persons engaged in the higher offices of teaching to be on the staff of several institutions, in addition to possessing the right of practice in their speciality.

The above will disclose the adequacy and variety of the teaching: this feature is characteristic not only of the Continental Technical High Schools, but also of the Continental Universities.

3. *Laboratory and General Equipment.*—Next to the teaching staff, the material equipment is very important, and the following account is given with a view to disclosing how complete it is in the technical universities of Europe.

The equipment for instruction in the Munich Technical High School consists of the following collections and "Institutes":—

1. Library and reading-room. 2. Mathematical Institute. 3. Geodetical Institute, associated with hydrometrical experimental station. 4. Physical Institute. 5. Laboratory for Technical Physics. 6. Collection for Applied Physics, associated with optical experimental station. 7. Electro-technical Laboratory, associated with an electro-technical collection. 8. Chemical laboratory, associated with an electro-chemical division and a preparation collection. 9. Chemico-technical Laboratory, with an associated Technological Collection. 10. Laboratory for Gas Analysis. 11. Laboratory for the Chemistry of Fermentation. 12. Mineralogical-Geological Collection. 13. Mineralogical Laboratory. 14. The Mechanico-technical Laboratory (principally for the investigation of elasticity). 15. Collection of materials of Construction. 16. Collection of Models for Civil Engineering. 17. Collection of Designs for Architectural Engineering. 18. Collection for Engineering Science and Theory of Construction. 19. Architectural Collection. 20. Collection of plans for Civil Construction. 21. Collection for the Theory of Architectural Construction. 22. Collection of plans of Engineering and Architectural Drawings. 23. Collection for Interior Decoration and Perspective. 24. Friedrich von Gärtner'sche Collection of Plans and Studies. 25. Collection of models for Mechanical Constructions, associated with a Mechanical Workshop. 26. Collection of plans of the division of Mechanical Engineering. 27. Laboratory for the Theory of Machines. 28. Collection for Mechanical Technology. 29. History of Art, Collection. 30. Statistical Collection. 31. Geographical Collection. 32. Collection for Freehand Drawing. 33. Collection for Descriptive Geometry. 34. Collection for Plan Drawing. 35. Collection for Modelling. 36. Agricultural Central-Experimental Station, associated with the Laboratory for Agricultural Chemistry. 37. Agricultural Collection. 38. Agricultural Laboratory, associated with an Experimental Field.

State Scientific Collections in the Special Buildings, which are at the disposal of the Technical High School, are the following:—

1. The State Library. 2. The Zoological-Zootomical Collection. 3. The Botanical Gardens. 4. The Mineralogical Collection. 5. The Palæontological Collection. 6. The Physiological Institute. 7. The Hygienic Institute.

The Royal Collection of Works of Art is also available, viz.:—

1. The old Picture Gallery. 2. The new Picture Gallery. 3. The Collection of Engravings and Sculpture. 4. The National Museum. 5. The Collection of Vases. 6. The Cabinet of Copper-plate Engravings. 7. The Antiquarium. 8. The Museum of Plaster-of-Paris casts of Classic Sculpture.

The equipment is excellent and extensive.

4. *Subjects of Instruction, Munich Technical High School.*—A detailed list of the subjects of instruction will aid any attempt to appreciate the grade of instruction afforded in the technical high schools of Germany. Those of the *Technische Hochschule zu München* are given hereunder. It may be pointed out that there are a great variety of subjects, and that students are free to take those they require.

In the special plans of study, the obligatory courses only are entered. Students who have had a *classical* preparation are required to spend a longer time, because of their deficiency in scientific knowledge, proper preparation being regarded as important.

5. *Courses in Mathematical Science.*—The courses cover a wide range, as is evident from the list hereunder, and embrace pure and applied mathematics.

A.—Pure and Applied Mathematical Sciences.

Algebraical Analysis and Trigonometry.—Four hours' lecture,[1] and one hour practice in winter and summer semesters.

Higher Mathematics, Part I.—Six hours' lecture and three hours' practice (in two groups) in winter: Elements of Plane and Solid Analytical Geometry. Elements of Differential and Integral Calculus.

Higher Mathematics, Part II.—Four hours' lecture and two hours' practice (in two groups) in summer: Continuation of Analytical Geometry, and of Differential and Integral Calculus. The most important applications of Differential and Integral Calculations on Geometry.

Higher Mathematics, Part III.—Five hours' lectures and three hours' practice (in two groups) in winter: General theory of Curves and Surfaces of the Second Order. Applications of Differential and Integral Calculus. Differential Equations. Elements of the Calculations of Variations.

Projective Geometry in Synthetical Treatment.—Four hours' lecture and one hour practice in winter and summer semesters.

Non-Euclidean Geometry.—Three hours in summer.

Mathematical Seminary, colloquium.—Two hours in summer and winter.

Mathematico-Historical Seminary.—Two hours in winter and summer.

Calculation of Probabilities and Method of Least Squares.—Two hours in winter.

Descriptive Geometry.—Four hours' lectures and four hours' practice (in groups) in winter and summer: Methods of Projection. Fundamental exercises on the point, straight line and plane. Representation of bodies, plane sections, and interpenetrant bodies. Developments, shadow constructions, and distribution of light.

Surveying

[1] Throughout this denotes the number of hours per week.

Surveying—

Part I: Four hours in winter.—Theory of instruments and simple Surveyor's Work, including Hydrometry.

Part II: Four hours in summer.—Trigonometrical Surveying, plan survey, marking out and work for preparation of maps, measurement of altitudes.

Practicum I: Two or four hours in winter.—Examination, adjustment, and use of measuring instruments.

Practicum II: Four or eight hours in summer.—Simple Surveyor's work on the Field.

Principal exercises in Surveying.—One or two weeks in the summer: connected with the survey of plan on a trigonometrical basis, setting-out, levelling and hydrometrical work.

Higher Geodesy and the Reduction of Observations.—Four hours in the winter.—Fundamental elements of reduction of observations; land surveying and geodetical work.

Cadastral Surveying.—Lectures: Three hours in winter and summer; arrangement of a cadastre. Old and new methods of cadastral surveying.

Practicum III: Eight hours in winter } Technical cadastral surveying; calculation and working-out.
Practicum IV. Ten hours in summer }

Exercises in Cartography.—Four hours in winter and summer.
Reduction of Observations—(Practicum): One hour in winter.
Mechanical and graphic calculation, slide-rules, arithmometers, planimeters, etc.—One hour in winter.
Elements of Astronomy.—Two hours in summer.
Methodology of Mathematical Geography.—One hour in winter.
Introduction to Analytical Mechanics.—Four hours in winter.
Technical Mechanics, including the Elements of Graphical Statics and Analytical Mechanics.—

Part I: Introduction to Mechanics: Statics and dynamics of a material point and of a rigid body in essentially elementary treatment; friction; calculation of simple machines. The elements of the theory of elasticity; impact; elements of hydrodynamics—Four hours in summer.

Part II: Graphical Statics: Forces in planes; polygon of forces; forces in space; application in structures in two or three dimensions: planes of distortion; lines of compression in arches; continuous girders.—Three hours in winter.

Part III: The Theory of Elasticity: The whole of the theory of technical elasticity, including Saint-Venant's problems.—Four hours in winter.

Part IV: Dynamics: Analytical mechanics of a material point and of a solid body; the pendulum; planetary motion; surfaces; d'Alembert's principle. Motion of a body with fixed points; the gyroscope; oscillation of waves and bridge-girders; hydrodynamic equations; irrotational motion; waves in water (according to Hagen); Poiseuille's law.—Three hours in the summer.

Higher Mathematics is a necessary preparation for the above.

Exercises in Technical Mechanics.—Two hours in winter.
Special exercises in Dynamics.—Two hours in summer.
Theory of Optical Instruments (telescope, microscope, photographic objective).—Two hours in winter.
Introduction to Theoretical Physics, Part I (Mechanics, elasticity, and heat).—Three hours in summer.
Introduction to the Theory of Elasticity and Hydrodynamics.—Three hours in the winter.
Special problems of the theory of Elasticity and Hydrodynamics.—Three hours in summer.
Partial differential equations of Mathematical Physics.—Four hours.
Outlines of the Theory of Fourier's series; cylindrical functions and spherical harmonics, and their application to physical problems.—Three hours in winter.
Exercises in the application of harmonic functions to physical problems.—One hour in winter.
Maxwell's Theory of Electricity and Magnetism.—Three hours in winter.
Calculation exercises in theoretical Physics.—Two hours in summer.
Theory of Potential in its application to Geophysics.—One hour in summer.

6. *Courses in Natural Science.*—These embrace both the pure and applied forms of Natural Science.

B. Pure and Applied Natural Sciences.

Experimental Physics.—Mechanics; the theory of heat; frictional, voltaic, and thermo-electricity.—Six hours in winter.
Magnetism, electro-magnetism, induction, optics.—Four hours in summer.
Physical Laboratory Practice.—Four or five hours in winter and summer.
Introduction to scientific research in the Department of Physics.—Forty-eight hours in winter and summer.
Experimental Acoustics.—One hour in summer.
Practice in the Mechanico-technical laboratory.—Two hours in summer (in groups).
The kinetic theory of gases.—Two hours in summer.
Technico-physical practice.—Four hours in winter and summer
Instruction as to the conduct of scientific work within the sphere of technical physics.—Total hours, forty-eight in winter and summer.
The mechanical theory of heat.—Two hours' lectures and one hour practice in winter.
Applications of thermodynamics to physico-chemical phænomena.—Two hours in winter.
Technical thermodynamics.—Two hours' lectures and one hour practice in winter.
Applied Physics (heating, ventilation, acoustics of buildings, lighting-conductors.—Three hours' lectures in winter, and two hours' practice in summer.
Photography, with special regard to helio-printing and multiplication processes.—One hour in winter and summer.
Inorganic Experimental Chemistry, including the outlines of physical chemistry.—Six hours in winter. For chemists' candidates, for the teaching of chemistry and the descriptive natural sciences, Customs Service applicants, candidates for mining, farming, and for students who desire to specialise in chemistry.

General Experimental Chemistry, including the outlines of organic chemistry.—Five hours in summer. For civil, agricultural, mechanical and electrical engineers, and for architects.

Chemical practice in the analytical and electro-chemical laboratory.—Ten to thirty hours in winter and summer.

Special work in the sphere of inorganic chemistry and electro-chemistry.—Thirty hours in winter and summer.

Organic Chemistry.—Five hours in summer. For chemists, candidates for the teaching of chemistry and descriptive natural sciences, and for farmers.

Chemical practice in the organic laboratory.—Twenty to thirty hours in winter and summer.

Chemistry of benzene derivatives.—Two hours in winter (I Part), and two hours in summer (II Part).

Pyridine, quinoline, isoquinoline, and the alkaloids.—One hour in summer.

Selected matter from Organic Chemistry, with regard to the literature of the day.—One hour in winter and summer.

Analytical Chemistry of Metals and Metalloids, together with gravimetric and volumetric analysis.—Part I, four hours in summer; Part II, two hours in winter.

Theoretical Electro-chemistry.—Two hours in winter.

Electro-chemical Processes.—Two hours in summer.

Chemical Cosmography.—One hour in winter.

Photo-chemistry.—One hour in summer.

Chemical Technology.—

I Part: The greater chemical industries.—Two hours in winter. Sulphuric acid, soda, fats, oils soaps, candles, common salt, chlorine, chloride of lime, potash, nitric acid. Explosives. Mineral dyes.

II Part: Four hours in winter.

(*a*) Mortars and cements (lime, cement, gypsum). Glassware and pottery. Illuminating gas, ammonia, and mineral oils. Sugar and fermentation industries. Two hours.

(*b*) Metallurgy and mining. Leather, caoutchouc, gutta-percha. Two hours.

III Part: Four hours in summer.—Organic dyes, including dyeing.

Practice in the Chemico-technical Laboratory.—Twenty to thirty hours in winter and in summer.

Chemical Technology of Water and Carbo-hydrates (Agricultural Technology, Part I): Three hours in winter.—Fermentation industries, including the manufacture of malt. Sugar and starch manufacture; starch preparations.

Chemistry of Foods, etc.—Two hours in summer.

Practice in the Chemistry of Fermentation, together with exercises in the investigation of foods, etc.—Altogether thirty hours in winter and summer.

Technology and the Knowledge of Merchandise (for the Customs Service)—

I Part: Inorganic wares.—Two hours in summer.

II Part: Organic wares with special regard to the fermentation industries.—Four hours in winter.

Combustibles and Furnaces, etc., inclusive of technical gas analysis.—Two hours' lectures in winter (Part I), and one hour in summer (Part II), then three hours' practice in technical gas-analysis in summer.

Mineralogy with demonstrations.—Four hours in summer.

Crystallography, in continuation of the lectures in Mineralogy.—One hour in summer.

Practice in Mineralogy (I).—Two hours in summer.

Practice in Mineralogy (II).—Two hours in winter.

Practice in Crystallography.—Two hours in winter.

Geology with demonstrations.—Four hours in winter.

Selected matter from applied Mineralogy and Geology.—Two hours in winter and summer.

Microscopy in Mineralogy and Geology.—Two hours' practice in summer.

Work in the Mineralogical-geological Laboratory.—Six to thirty hours in winter and summer.

Recapitulation of Mineralogy.—Two hours in winter.

Outlines of Palæontology (Palæozoology and Palæophytology), with special regard to the most important fossils.—Two hours in winter.

Geology of Bavaria.—Two hours in winter.

Recapitulation of Geology, with excursions.—Two hours in summer.

Exercises in the determination of fossils.—Two hours in winter and summer.

Petrography with exercises.—Two hours in summer.

Petrographical-Microscopy.—Two hours in winter and in summer.

General Botany (the principal features of morphology, anatomy, and physiology of plants.—Five hours' lectures in winter.

General Botany (structure, anatomy, morphology, and physiology of plants) with special regard to the problems of Technologists.—Three hours in winter.

Special and Systematic Botany, of the most important chemico-technical and agricultural plants.—Three hours in summer.

The Lower Fungi.—Two hours in summer.

Practice in Botanical Microscopy.

Methodology of Instruction in Natural Philosophy in Secondary schools.—One hour in winter.

History of the Older Botany.—One hour in summer.

Exercises in the determination of plants, with excursions.—One hour in summer.

Physiology.—Six hours in winter (Part I: Nutrition, and in summer Part II: Nerves, the organs of sense, and muscles).

General Zoology, including the theory of noxious animals.—Three hours in winter and four hours in summer.

The Hygiene of Buildings (for architects and engineers).—Two hours in summer.

The Hygiene of the Workmen.—One hour in winter.

7. *Building and Engineering Science.*—The courses embrace—(1) Engineering, (2) raised structures, (3) mechanical engineering, (4) electro-technics. Each of these will be detailed.

C.—Building and Engineering Science.

(1.) *Engineering.*

The theory of Building Construction for Civil and Agricultural Engineering.—Three hours lectures and six hours practice in winter and summer. Stone, wood, and iron constructions. Foundations. Also for agricultural engineers: Practice, Part II. Four hours in winter and in summer (construction of weirs, small bridges, etc.).

Necessary preparation.—Technical mechanics and descriptive geometry.

Roads and Railways.—Four hours in summer. Necessary preparation—Surveying.

Road and Railway Construction for Civil Engineers.—Four hours lectures and eight hours practice (design of earth structures, roadways, etc.) in winter; two hours lectures and eight hours practice (design of railway structures) in summer.

The necessary preparation embraces technical mechanics, the theory of building construction for engineers, and the theory of earth structures.

The theory of Railway construction for Architects: One hour in summer. Superstructure and arrangement of lines of rails for railway stations and platforms.

Bridge Construction.—Lectures: Theory of bridge beams, five hours in winter; stone, wood and iron bridges and foundations (with iron), five hours in summer. Practice: Part I. Statical calculation of bridge members, six hours in winter. Part II: Design of stone and wooden bridges, six hours in summer. Part III: Design of iron bridges, eight hours in winter.

Necessary preparation: Technical mechanics and theory of building construction for engineers.

Pillars, etc.—Two hours in winter.

Hydraulics.—Three hours' lectures in winter and in summer; practice for Architectural Engineers, nine hours in summer; practice for agricultural engineers, four hours in winter and eight hours in summer.

The construction of channels: General characteristics of streams, hydrometrical works regulation of torrential brooks, regulation of streams and canalisation.

Canals: Design, execution and maintenance of navigable canals.

Aqueducts: Drainage and irrigation of soils, canals for power-plant, water supply, municipal canalisation.

The necessary preparation embraces surveying, technical mechanics, and the theory of building construction for engineers.

Direction of the lines of Railways and other traffic routes, two hours lectures in summer.

Necessary preparation embraces surveying, the theory of road, railway and bridge construction.

Hospitals.

Necessary preparation: Theory of building construction for Architects.

Architecture for Civil Engineers.—Two hours lectures and four hours practice in winter; Plans of dwelling-houses; Railway buildings.

Architecture for Mechanical Engineers.—Two hours lectures in winter and two hours practice in summer.

Agricultural Architecture, Part I.—(For Architects and Agricultural Engineers.)—Two hours lectures; two hours practice for Architects; six hours practice for Agricultural Engineers in winter.

Agriculture Architecture, Part II.—Two hours lectures and two hours practice in summer; buildings for secondary industries of Agriculture.

Design of the Renaissance buildings, fourteen hours practice in winter and summer

Theory of Shadow Construction.—One hour lecture and two hours practice in winter; determination of the shadow limits and lines of equal brightness on the surface of architectural forms.

Perspective.—One hour lecture and two hours practice in winter; one hour lecture and four hours practice in summer; then two hours practice in winter (for the third Course). General introduction. Description of the individual elements of Architecture and of the complete construction. Perspective theory of illumination. History of Perspective.

Interior Decorations.—One hour lecture and four hours practice in winter and summer. The styles of wall decorations, plain ceilings and floors. The forms of decorations of various kinds of arches, ceilings, etc.

Estimates of costs for buildings, including the plans and the conditions of contract, two hours in summer

City Buildings.—One hour lecture in winter and summer. Historical development of houses of peasants. two hours lectures and two hours practice in winter.

Bridges, Railways and Hydraulic Works for Mechanical Engineers, three hours lecture in winter; two hours lectures and two hours practice in summer.

In winter: Iron bridges.

In summer: Railroad superstructure, waterworks, designing of iron bridges.

Estimates of cost of engineering constructions, two hours in summer.

Necessary preparation: General and special building construction of the corresponding professional divisions.

(2.) *Raised Structures.*

Building Construction for Architects, Part I. (The theory of raised structures generally and for agricultural and mechanical engineers).—One hour lecture and four hours practice for architect, two hours practice for agricultural and mechanical engineers, in winter and in summer). Simple stone and wooden constructions, as far as the design and construction of small buildings requires. Description of simple buildings in all their parts.

Necessary preparation: Technical Drawing.

Building Construction for Civil Engineers, Part I., and elements of constructional theory, one hour lectures and four hours practice in winter and in summer. Simple stone and wood constructions of buildings and their formal development.

Building

Building Construction for Architects and Civil Engineers, Part II. Three hours lectures and six hours practice in winter and summer for Architects; three hours lectures and four hours practice in summer for Civil Engineers—stone, wood and iron constructions; finishing of interiors. Statics of Building Constructions, two hours lectures in summer.

The necessary preparation embraces Technical Mechanics, Parts I. and II.

Original Constructive Exercises in Designs.—Two hours in winter and in summer.

Necessary preparation: Designs of buildings (at least one Semester).

Theory of Materials of Construction.—Three hours in winter and two hours in summer. In winter: natural stone, one hour; artificial stone and cements, two hours. In summer: Wood and metals.

Theory of the Forms of Ancient Architecture.—One hour lecture in winter and in summer; four hours' practice in winter and six hours in summer.

The theory of the forms of the Greek and Roman Architecture: Pedestal, pillar, and capitals of the various orders. Foundations, pillars and walls, ceilings and roofs, windows and doors.

Theory of the Forms of the Renaissance, Part I.—One hour lectures and four hours' practice in winter and summer. Detail forms. The arrangement of columns and arches. Doors and windows, the parts of façades.

Necessary preparation; the theory of shadow construction.

Theory of the Forms of the Renaissance, Part II.—(The formation of façades.) Two hours' practice in winter and summer.

Styles of Ancient Architecture.—Lectures: Two hours in winter and three hours in summer. Exercises: Two hours in winter and summer.

In winter: The Grecian style of Architecture.

In summer: Roman style of Architecture.

Style of Architecture of the Renaissance.—Two hours in summer. *Mediæval Architecture.*

(1.) Theory of forms and styles of the Roman and Gothic Architecture.—Two hours' lectures and four hours' practice in winter and summer.

(2.) Design of buildings of small extent, with development of details.—Four hours' practice in winter and summer.

(3.) Design of buildings of great extent, with development of details.—Four hours' practice in winter and summer.

Civil Architecture.—Four hours' lectures and eight hours' practice in winter, three hours' lectures and eight hours' practice in summer. General principle of the design of buildings. Plans of dwelling-houses. Railway buildings. School buildings. Plans of baths.

(3.) *Mechanical Engineering.*

Construction of parts of Machines, Part I.—Six hours in winter. Introduction: Bolts, screws, and keys, and other connecting devices. Shafting, coupling. Friction and spur-wheels. Transmission. Raising mechanisms. Winch mechanism.

Design of parts of Machines, Part I.—Eight hours for Mechanical Engineering and six hours for Electrical Engineering in winter.

Theory of Construction of parts of Machines, Part II.—Three hours in summer. Pipe connections, valves, pistons, etc.

Design of parts of Machines, Part II.—Eight hours for Mechanical Engineers and six hours for Electrical Engineers in summer.

Necessary preparation: Technical Mechanics, Parts I and II.

Introduction to the Theory of the Construction of Working Mechanisms.—One hour in summer. Chains, pulleys, winches, etc., etc.

Design of Machinery, Part I.—Six hours in winter.

Theory of construction of machinery, Part I.—Two hours in winter. Cranes, pumps, presses, etc.

Designs of machinery, Part I.—Six hours in winter. Necessary preparation: Technical mechanics, and theory of construction of the parts of machines.

Theory of construction of the composition of machines, Part II.—Two hours in winter and in summer.

In winter: Pumping plant, hydraulic machinery.

In summer: Blast engines, air-compression machines, etc., etc.

Design of Machinery, Part II.—Six hours in summer. Necessary preparation: Theory of construction of hydraulic and steam engines.

Hydraulic Engines.—Six hours in winter. Theory, construction, and experimental investigation of water-wheels and turbines.

Design of Hydraulic Engines.—Eight hours in summer.

Necessary preparation: Theory of construction of parts of machines.

Theory of the Construction of Steam-engines.—Six hours in summer. Summary of systems of steam-engines. Boiler feeding-pumps. Condenser apparatus. Preparatory heater. Steam cylinder, with its fittings, regulator, or governor.

Design of Steam-engines.—Eight hours in winter. Necessary preparation. Construction of parts of machines and theoretical mechanical engineering, Part I.

Boilers and Furnaces.—Two hours in winter. Furnace arrangements. Heating surface. Summary of the various types of boiler. Boiler fittings.

Design of Boilers.—Two hours in summer.

Theory of Construction of Railway Locomotives.—Four hours in winter. Various details of locomotives. Main features of railway carriages. Watering stations. Carriage building. Locomotive construction.

Design of Railway Engines.—Two hours in summer. Necessary preparation: Theory of construction of parts of machines.

Theoretical

Theoretical Mechanical Engineering—

Part I.—Three hours in winter and four hours in summer.

In winter: General theory of construction (Laws of motion and regulation).

In summer: Theory of heat-engines, Part I.—(Steam-engines) Necessary preparation: Technical mechanics, and mechanical theory of heat.

Part II.—Two hours in winter and in summer.

Theory of heat-engines, Part II.—(Hot-air engines; gas and petroleum motors.)

Practice in Theoretical Mechanical Engineering.—(Graphical solution of problems in theoretical mechanical engineering.) Two hours in winter (in groups).

Laboratory Practice in Theoretical Mechanical Engineering.—Two hours in summer (in groups), viz.:—

(*a*) For students of the third course: Use and testing the measuring instruments.

(*b*) For the students of the fourth course: Experimental investigation of power-engines.

Theory of Refrigerating Machinery.—Two hours in winter. Necessary preparation: Mechanical theory of heat.

Kinematics.—Three hours in summer.

Mechanical Technology.—Six hours in winter (Part I), and five hours in summer (Part II).

In winter—Treatment of metals and wood with special regard to machine-tools.

In summer—Spinning and weaving of cotton, flax, jute, wool, and silk.

Selected matter from Mechanical Technology.—In a three-yearly rotation of lectures in the summer semester (1) Manufacture of paper, (2) Mills and their equipment, (3) Factories and their equipment.

Elementary Mechanics as an introduction to General Engineering.—Two hours in winter. The principles of the mechanics of solid bodies.

Elements of elasticity. Mechanics of fluid and gaseous bodies.

General Engineering.—Three hours in winter and four hours in summer.

In winter—(1) The parts of machines.

(2) Workshop machinery (Part I)—Lifting appliances, pumps, blast-engines, compressors, rammers, dredgers, pulverisers, etc., etc.

In summer—(1) Power-engines (hydraulic-engines, steam-engines with boilers), three hours.

(2) Work machines (Part II).—One hour.

(*a*) For Civil Engineers—construction: Locomotives.

(*b*) For Chemists: Transport engines, mixing and sifting machines, presses, etc.

(4.) *Electro-technics.*

Elements of Electro-technics.—Two hours in winter and three hours in summer, then two hours' practice in summer.

Electro-technics for Mechanical Engineers and Chemists.—Two hours in summer. The fundamental laws of Electro-dynamics and Induction. Electro-technical measurements. Galvanic batteries and accumulators. Machines for the production of continuous and monophase and polyphase alternating currents. Transformers and motors, and their use in lighting, transmission of power, and electro-chemical works. Electric railways.

Electro-technic Measurement.—Two hours in winter and in summer.

Theory and Construction of Measuring Instruments and Electrical Meters.—Two hours in summer.

Technics of Lighting and Construction of Arc-lamps.—Two hours in winter.

Electrical Switch and Regulating Apparatus.—One hour in winter and two hours in summer.

Telegraphy and Telephony.—Two hours in winter.

Electro-technical Practicum—

Practicum I (Technique of measurement and photometry).—Eight hours in winter and four hours in summer.

Necessary preparation: Experimental physics and knowledge of physical laboratory practice.

Practicum II (Electric-machine measurements, continuous current, transformers, etc.).—Eight hours in winter and four in summer.

Necessary preparation: The knowledge acquired in Practicum I in Electro-technics.

Electro-technical Practicum for Advanced Students.—In all twenty to thirty hours in winter and summer.

Part I: Continuous current generators and transformers.—Three hours in winter.

Part II: Alternating current generators and synchronous motors.—Four hours in summer.

Part III: Transformers and a synchronous motor.—Three hours in winter.

Design of Electrical Machines.—Four hours in winter and summer.

Electrical transmission of energy and central installation.—Two hours' lectures in winter and summer, then four hours' practice in summer.

Electrical Railways.—Two hours in winter and one hour in summer.

8. *Courses in Agricultural Science.*—The courses in Agriculture are as follow:—

D.—Agricultural Science.

Comparative Anatomy of Domestic Animals.—Three hours in winter.

Embryology and History of the Development of the Domestic Animals.—Two hours in summer.

General Meteorology and Climatology with special regard to agriculture and forestry.—Fours hours in winter.

Science of Agriculture and Chemistry of Soils.—Five hours in winter.

Agricultural Chemistry—

Part I: The nourishment of plants.—Two hours in summer.

Part II: Feeding of animals of service agriculturally.—Three hours in winter.

Practicum in Agricultural Chemistry.—In winter and summer combined.

General

General Agriculture and Botany, with demonstrations in the agricultural laboratory.—Four hours' lectures in winter combined with practice.
The Rearing of Plants.—One hour in summer.
Cultivation of Special Plants.—Two hours in winter (I Part) and in summer (II Part).
Ameliorations, with demonstrations.—Three hours in summer.
Meadow-cultivation, with demonstrations.—Two hours in summer.
Moor-cultivation.—One hour in winter.
Agricultural Implements and Machines.—Three hours in summer.
General Theory of Animal-breeding and Hygiene.—Three hours in winter.
Special Theory of Animal-breeding, with demonstrations.—Four hours in winter and summer. Breeds, judgment, breeding, maintenance, and feeding.

(*a*) Of the ox.—Two hours in winter.
(*b*) Of the sheep (including the wool).—Two hours in winter.
(*c*) Of the horse.—Three hours in summer.
(*d*) Of the pig.—One hour in summer.

Poultry-breeding.—One hour in summer.
Pisciculture.—Two and a half hours in winter.
Agricultural pursuits—

Ist Part: Husbandry.—Three hours in winter.
IInd Part: The organisation of husbandry.—Three hours in summer.

Agricultural Calculations.—One hour in summer.
Theory of Agricultural Taxation.—One hour in summer
Agricultural Technology—

Part I: Fermentation industry; manufacture of sugar and starch.—Three hours in winter.
Part II: Dairying with demonstrations on the State farms at Weihenstephan.—Two hours in summer.

Agricultural Architecture.—Two hours in summer.
Diseases of Agricultural Plants.—Two hours in summer.
Theory of diseases peculiar to animals, with demonstations.—Two hours in summer.
Practice in Zootomy and Horse-shoeing.—Two hours in winter.
Agricultural Experimental stations.—One hour in summer.
Exercises in the valuation of soils.—One hour in summer.
Demonstrations on the experimental fields and on the State farms at Weihenstephan for this purpose: Scientific studies in the *Agricultural Laboratory* and on the experimental field in summer.

9. *Courses in Drawing and Modelling.*—These courses include all that is necessary for the artistic side of professional education. They are as hereunder:—

E.—Drawing and Modelling.

Ornamental Drawing.—Drawing of ornaments of various epochs of art from the round.
Figure Drawing.—Drawing of heads, individual parts of the body, and the complete figure from the flat. Drawing from the antique.
Landscape Drawing.—(The rooms for freehand drawing are open throughout the day).
Water-colour Drawing.—Three hours in winter and summer.
Design of Ornaments.—Two hours in winter and summer.
Sketching of Architectural works, from nature.—Two hours in summer.
Technical Drawing.—Elements of stone-cutting, stone, wood, and iron structures. Drawing of surveying instruments.—Four hours in winter for civil engineers and architects; two hours in winter and four hours in summer for agricultural and survey engineers.
Plan and Map Drawing.—Execution of ground plans and elevations. Descriptive physiography. Cadastral plans. Four hours in winter and summer for civil, agricultural, and survey engineers.
Mechanical Drawing.—Four hours in winter and summer. Measurement of machines and sketching from drawings and models. Sketching from geometrical dependence—development of sketches into working drawings and details on a small scale.
Modelling.—Sculptural studies. Modelling in clay and plastiline. Copying from ornamental and figure models. Sketching of small architectural and architectonic details from one's own design. (The rooms for modelling are open throughout the day).

10. *Courses in General Subjects.*—These courses are literary, historical, æsthetic, geographical, economic, pædagogical, and linguistic.

General Subjects.

History of German Literature of the 19th Century.—Three hours in winter and summer. In winter: Part I (From the appearance of romantic poetry to the death of Goethe). In summer: Part II (From Goethe's death to the re-establishment of the German Empire).
Comparison of selected passages from the Middle High German Poets—chiefly Wolfram of Eschenbach, and Gottfried of Strassburg—with their old French originals.—Two hours in winter.
The Relations of German and French Literature in the Middle Ages.—Two hours in summer. *Shakespeare's Tragedies:* Two hours in winter.
General History of Art.—Four hours in winter and summer:—

In winter: Part I (From the earliest times to the beginning of the Gothic period).
In summer: Part II (From the beginning of the Gothic period to the end of the Renaissance).

Explanation

Explanation of Antiquities of Munich.—Two hours in summer.
Outlines of Æsthetics.—One hour in winter.
The History of Art of the 19th Century.—One hour in summer.
Æsthetic Questions of the Day—One hour in summer.
Michelangelo.—One hour in winter.
The Graphic Arts of the 19th Century—One hour in summer.
Bavarian National Museum.—One hour in winter and summer:—

In winter: Part I (To the beginning of the Renaissance).
In summer: Part II (From the beginning of the Renaissance to the present time).

History of Universal Commerce.—Two hours in winter, Part I, and in summer Part II.
The Period of Prince Bismarck.—Two hours in winter.
History in the Reformation Period.—Two hours in summer.
General Historical Facts in the Development of Bavaria —Two hours in winter.
The Works of Art of Bayreuth from the point of view of historical culture.—Two hours in winter.
The Historical Romance in its relation to history.—Two hours in summer.
Historical Seminary.—Two hours in winter and summer.
General History of Pædagogy.—Two hours in winter.
Outlines of Pædagogy.—Two hours in summer.
Pædagogical Seminary.—One hour in summer.
Commercial and Political Geography.—Part I, two hours in summer; Part II, two hours in winter.
Geography of America.—Three hours in winter, Part I, and in summer Part II.
Geographical Seminary.—Two hours in winter and summer.
Ethnology.—Two hours in winter.
The Tropics.—Two hours in summer.
The Effect of the Glacial Period on the Surface of Europe.—One hour in summer.
Geography of Bavaria.—One hour in winter.
National Economy.—Four hours in winter.
Bavarian State Law.—Three hours in winter.
Financial Science.—Four hours in summer.
General Statistics.—Two hours in summer.
The French Language.—Lectures, four hours in winter and summer; practice, one hour in winter.
The English Language.—Lectures, two hours in winter and three hours in summer; practice, two hours in winter.
Italian Language.—Lectures, two hours in winter and three hours in summer; practice, two hours in winter.

11. *The General Division, Munich Technical High School.*—There is a general division for two classes of students, viz.:—

(I) Candidates for teaching in humanistic and technical teaching establishments.
(II) Students of technical physics.

Strictly, there are no detailed plans of studies for these, and students attend the courses they think will be of most service to them.

There are about seven lines of preparation, which are—

(1) Mathematics and Physics; (2) Chemistry; (3) Descriptive Natural Science; (4) German History, and Geography; (5) Modern Language; (6) Drawing and Modelling; (7) Commercial Science.

The fundamental lectures in (1), given in the first year, are—

(i) Algebraical Analysis; (ii) Higher Mathematics, Parts I and II, which embrace Differential and Integral Calculus, Analytical Geometry of two and three dimensions; (iii) Synthetic Geometry; (iv) Descriptive Geometry; (v) Experimental Physics; (vi) General Experimental Chemistry; (vii) Elements of Spherical Astronomy.

Besides these, two lectures a week on philosophic, historical, or geographical subjects are taken; all being taken in the two first years.

In the third and fourth years the interdependence of elementary mathematics and general studies, and facility in experimental work, is accentuated.

Under the heading of descriptive natural science, mineralogy, crystallography, geognosy, geology, botany, and zoology are taken. The courses include both lectures and the work in the "*Praktikum.*"

Under the heading of drawing and modelling are included linear, *i.e.*, technical drawing, descriptive geometry, shadow construction, forms of classic and renaissance architecture, perspective, and the history of art.

The plan of studies for students of technical physics is four years. In the third and fourth years the principal work is in the laboratories of technical and experimental physics, electrotechnics, technical mechanics, and theoretical mechanics. The lectures on the higher branches of applied mathematics include partial differential equations of physics, theory of potential probability, theory of heat, theory and method of physical measurement, kinetic theory of gases, Maxwell's theory, and similar matters.

Candidates for the Customs service take three semesters, as follows:—

Experimental physics, 6, 0, 0; inorganic experimental chemistry with physical chemistry, 6, 0, 0; technology and merchandise, with special regard to the ferment industries, 0, 2, 4; State Law of Bavaria, 0, 0, 3; national economy, 4, 0, 0; statistics, 0, 2, 0; financial science, 0, 4, 0; commercial history, 2, 2, 0; commercial geography, 0, 2, 2; French, 4, 4, 1; English, 2, 3, 2; Italian, 2, 3, 2. In the languages, the last number expresses the hours per week of *practice;* in all other cases, the numbers denote the hours per week of lectures.

12.

12. *Course for Civil Engineers.*—The programme of studies for Civil Engineers is as follows:—

PROGRAMME FOR CIVIL ENGINEERS, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
First Year.				
Higher Mathematics, Part I ...	6	3	...	...
Higher Mathematics, Part II...	...	...	4	2
Descriptive Geometry...	4	4	4	4
Experimental Physics ...	6	...	4	...
General Experimental Chemistry, including the outlines of Organic Chemistry ...	...	...	5	...
Technical Mechanics, Part I (Introduction to Mechanics) ...	...	...	4	...
The Theory of Building Construction for Civil Engineers, Part I, and Elements of the Theory of the forms of Construction ...	1	4	1	4
(*a*) *The Abiturienten of the Classical Gymnasia take:*—				
Algebraical Analysis and Trigonometry ...	4	...	4	1
Optional: Exercises in Algebraical Analysis and Trigonometry (1 hour in winter and summer), and Technical Drawing (4 hours in winter).				
(*b*) *The Abiturienten of the* (*Bavarian*) *Realgymnasia take:*—				
Algebraical Analysis ...	...	...	4	...
Optional: Exercises in Algebraical Analysis (1 hour in summer).				
Second Year.				
Higher Mathematics, Part III ...	5	3	...	...
Technical Mechanics, Part II (Graphic Statics) ...	3	...	...	...
Technical Mechanics, Part III (Theory of Elasticity) ...	4	...	...	...
Technical Mechanics, Part IV (Dynamics) ...	...	...	3	...
The Theory of Building Construction for Civil Engineers... ...	3	6	3	6
The Theory of the Materials of Construction ...	...	...	2	...
Mineralogy ...	...	...	4	...
Plan and Map Drawing ...	...	4	...	4
Third Year.				
Surveying ...	4	2	4	8
Principal Exercises in Surveying ...	...	...	2 weeks.	
Theory of Earthworks, etc. ...	...	...	4	...
Bridge-building... ...	5	6	5	6
Theory of Building Construction for Civil Engineers, Part II ...	...	...	3	4
Theory of Materials of Construction ...	2	...	...	...
Geology... ...	4	...	...	...
National Economy ...	4	...	...	...
Optional: Building Hygiene (2 hours in summer).				
Fourth Year.				
Higher Geodesy and the Reduction of Observations ...	4	...	...	...
Theory of Road and Railway Construction ...	4	8	2	8
Galleries, Tunnels, etc. ...	2	...	...	...
Hydraulics ...	3	...	3	9
Designing of Iron Bridges	...	8	...	...
The Direction of Railway Lines and other Traffic Routes	...	...	2	...
General Engineering	3	...	4	...
Architecture for Civil Engineers ...	2	4	...	...
Estimate of Cost of Engineering Works ...	...	...	2	...
Bavarian State Law (obligatory for the Public Service Candidates)	3	...	...	...

13. *Course for Agricultural Engineers.*—A distinct profession known as Agricultural Engineering has lately arisen in Europe, and agricultural engineers (*Kulturingenioure*) are competent to advise on all questions of agriculture. The details of the course are as follows:—

PROGRAMME IN AGRICULTURAL ENGINEERING, MUNICH TECHNICAL HIGH SCHOOL.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice
First Year.				
Higher Mathematics, Part I ...	6	3	...	...
Higher Mathematics, Part II ...	...	...	4	2
Descriptive Geometry ...	4	4	4	2
Experimental Physics ...	6	...	4	...
General Experimental Chemistry, including the outlines of Organic Chemistry ...	...	...	5	...
Technical Mechanics, Part I (Introduction to Mechanics) ...	...	...	4	...
General Botany ...	3	...	...	...
National Economy ...	4	...	...	...
(*a*) *The Arbiturienten of the Classical Gymnasia take:*—				
Algebraical Analysis and Trigonometry ...	4	...	4	...
Optional: Practice in Algebraical Analysis and Trigonometry (1 hour in winter and summer), and Technical Drawing (2 hours in winter and 4 hours in summer).				
(*b*) *For those who have been Students of the Realgymnasia*:—				
Algebraical Analysis ...	...	...	4	...
Optional: Practice in Algebraical Analysis (1 hour in summer).				
Surveying ...	4	4	4	8
Principal Exercises in Surveying ...	...	...	2 weeks.	
Technical Mechanics, Part II (Graphic Statics) ...	3	...	...	...
Technical Mechanics, Part III (The Theory of Elasticity) ...	4	...	...	...
The Theory of Building Construction for Agricultural Engineers	3	6	3	6
Special and Systematic Botany ...	...	...	3	...
Agricultural Chemistry (the Nutrition of Plants) ...	...	...	2	...
The General Theory of Arable Land and the Growth of Plants, with Exercises in the Estimation of the Value of the Soil ...	4	...	...	1
Theory of Materials of Construction ...	...	...	2	...
Mineralogy ...	...	...	4	...
Third Year.				
Geology ...	4	...	...	...
Science of Agriculture and Chemistry of the Soils ...	5	...	...	...
Meteorology and Climatology ...	4	...	...	...
Agricultural Systems of Amelioration ...	...	...	3	...
The Cultivation of Moors ...	1	...	...	...
The Cultivation of Meadows ...	...	...	2	...
Special Growth of Plants ...	2	...	2	...
The Theory of Materials of Construction ...	3	...	...	...
Earthworks ...	...	...	4	...
The Theory of Building Construction for Agricultural Engineers	1	2	1	2
The Theory of Agricultural Implements and Machines ...	...	...	3	...
The Theory of Building Construction for Agricultural Engineers	...	4	...	4
Plan and Map Drawing ...	...	4	...	4
Fourth Year.				
The Theory of Waterworks ...	3	4	3	8
The Theory of Road-making ...	4	8	...	...
Agricultural Architecture, Part I ...	2	6	...	...
Estimate of Costs for Engineering Constructions ...	...	...	2	...
General Engineering ...	3	...	3	...
Bavarian State Law (obligatory for aspirants to the Public Service) ...	3	...	...	...
Optional: Agricultural Architecture, Part II (2 hours' lectures and 2 hours' practice in summer).				

Course

Course in Geodetical Engineering.—The course for Surveyors or Survey Engineers (*Vermessungsingenieure*) is developed as hereunder:—

PROGRAMME IN SURVEYING, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
First Year.				
Algebraical Analysis and Trigonometry	4	1	4	1
Higher Mathematics, Part I	6	3	...	...
Higher Mathematics, Part II...	...	...	4	2
Descriptive Geometry	4	4	...	...
Surveying	4	4	4	8
Principal Exercises in Surveying	...	...	2 weeks.	
Plan, Map, and Cadastral Drawing	...	4	...	4
The Arbiturienten of a Classical Gymnasium must take Experimental Physics	6	...	4	...
Optional: Technical Drawing (2 hours in winter and 4 hours in summer).				
Second Year.				
Higher Geodesy and Reduction of Observations	4	...	...	...
Cadastral Surveying	3	8	3	10
The Theory of Earthworks, etc.	...	...	4	...
The General Theory of Agriculture and Horticulture	4	...	...	...
Agricultural Amelioration	...	...	3	...
Meadow Cultivation	...	...	2	...
Practice in Topography, etc.	...	4	...	...
Bavarian State Law (obligatory for candidates of the Public Service)	3	...	...	...

14. *Courses in Architecture.*—The courses in Architecture are differently arranged according as the candidates have gone through the Realgymnasium, Industry School, or *Oberrealschule*, or, on the other hand, the Classical Gymnasium. The programmes are as hereunder:—

PROGRAMME IN ARCHITECTURE, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
(a) *For Arbiturienten of the Realgymnasium, Industry Schools, Oberrealschulen, etc.*				
First Year.				
Higher Mathematics, Part I	6	3	...	...
Descriptive Geometry...	4	4	4	4
Experimental Physics	6	...	4	...
General Experimental Chemistry, including outlines of Organic Chemistry	...	...	5	...
Technical Mechanics, Part I (Introduction to Mechanics) ...	...	...	4	...
Theory of Building Construction for Architects, Part I	1	4	1	4
Theory of forms of Ancient Architecture	1	4	1	6
Theory of the Construction of Shadows	1	2	...	...
Ornamental Drawing	...	4	...	4
Arbiturienten of the Realgymnasia, take: Algebraical Analysis ...	...	...	4	...
Optional: Exercises in Algrebraical Analysis (1 hour in summer)				
Second Year.				
Technical Mechanics, Part II (Graphic Statics)	3	...	...	...
Statics of the Construction of Buildings	...	...	2	..
Theory of Building Construction for Architects, Part II... ...	3	6	3	6
Theory of Materials of Construction	3	...	2	...
General History of Art	4	...	4	...
Architectural styles of Antiquity	2	...	3	...
Theory of Mediæval Architectural forms and styles	2	4	2	4
Theory of forms of the Renaissance, Part I	1	4	1	4
Perspective	1	2	1	4
Ornamental and Figure Drawing	1	4	...	4
Optional: Exercises at the conclusion of the lectures in the styles of Architecture of Antiquity (2 hours in winter and summer)				

Subjects.	Hours per week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
Third Year.				
Surveying	4	2	...	4
Applied Physics (Heating, Ventilation, etc.)	3	...	...	2
Civil Architecture	4	8	3	8
Agricultural Architecture, Part I	2	2	...	...
The Architecture of the Middle Ages (designing of buildings of small extent)	...	4	...	4
The Theory of Forms of the Renaissance, Part II	...	2	...	2
Perspective	...	2	...	...
The Theory of Earthworks, etc.	...	...	4	...
Ornamental and Figure Drawing	...	4	...	4
Modelling	...	6	...	6
Optional: Principal exercises in Surveying for a week (in summer). Constructive exercises in individual designs (2 hours in summer). Agricultural Architecture, Part II (2 hours lectures and 2 hours practice in summer).				
Fourth Year.				
Style of Architecture of the Renaissance	...	...	2	...
Designs of the buildings of the Renaissance	...	14	...	14
The Architecture of the Middle Ages (designs of buildings of great extent)	...	4	...	4
Interior Decorations	1	4	1	4
Æsthetics	1	...	...	...
Estimate of Cost of Constructions	...	...	2	...
Theory of Railway Construction for Architects	...	...	1	...
General Engineering	3	...	...	...
Hygiene of Buildings	...	...	2	...
Bavarian State Law (obligatory for candidates for the Public Service	3	...	...	...
Ornamental and Figure Drawing	...	4	...	4
Modelling	...	6	...	6
Optional: Municipal Architecture (1 hour lectures in winter and summer). Historical Development of Peasant's houses (2 hours' lectures and 2 hours' practice in winter).				
(b) *For arbiturienten of the Classical Gymnasium.*				
First Year.				
Algebraical Analysis and Trigonometry	4	...	4	...
Descriptive Geometry	4	4	4	4
Experimental Physics	6	...	4	...
General History of Art	4	...	4	...
Ornamental Drawing	...	6	...	6
Technical Drawing	...	4	...	...
Optional: Exercises in Algebraical Analysis and Trigonometry (1 hour in winter and summer).				
Second Year.				
Higher Mathematics, Part I	6	3	...	...
General Experimental Chemistry, including the principal characteristics of Organic Chemistry	...	...	5	...
Technical Mechanics, Part I (Introduction to Mechanics) ...	...	...	4	...
Theory of Building Construction for Architects, Part I	1	4	1	4
The Theory of Forms of Ancient Architecture	1	4	1	6
The Theory of Shadow Construction	1	2	...	...
Ornamental and Figure Drawing	...	4	...	4
Third, fourth, and fifth years: Similar to the 2nd, 3rd, and 4th years for the Arbiturienten of the Realgymnasien, etc., with the exception of the History of Art.				

15. *Course in Mechanical Engineering.*—The course in Mechanical Engineering is a 4-year course, the programme of which is developed as hereunder :—

PROGRAMME IN MECHANICAL ENGINEERING, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semister.		Summer Semister.	
	Lectures	Practice.	Lectures.	Practice.
First Year.				
Higher Mathematics, Part I	6	3	...	...
Higher Mathematics, Part II...	...	...	4	2
Descriptive Geometry...	4	4	4	4
Experimental Physics	6	...	4	...
General Experimental Chemistry, including outlines of Organic Chemistry	...	...	5	...
Technical Mechanics, Part 1 (Introduction to Mechanics) ...	...	...	4	...
Mechanical Drawing	...	4	4	...
Arbiturienten of the Classical Gymnasia, take: Algebraical Analysis and Trigonometry	4	...	4	...
Optional: Exercises in Algebraical Analysis and Trigonometry (1 hour in winter and summer).				
(*b*) *Arbiturienten of the (Bavarian) Realgymnasia, take:* Algebraical Analysis	...	...	4	...
Optional: Exercises in Algebraical Analysis (1 hour in summer).				
Second Year.				
Higher Mathematics, Part III	5	3	...	...
Technical Mechanics, Part II (Graphic Statics)	3	...	...	...
Technical Mechanics, Part III (The Theory of Elasticity) ...	4	...	...	...
Technical Mechanics, Part IV (Dynamics)	...	...	3	...
Theory of Construction of Parts of Machines	6	...	3	...
Designing of Parts of Machines	...	8	...	8
Introduction to the Theory of Construction of Power Machines ...	...	...	1	...
Mechanical Technology	6	...	5	...
Kinematics	...	...	3	...
Physical Laboratory Practice...	...	4	...	...
Third Year.				
Surveying	4	2	...	4
Principal exercises in Surveying	...	...	1 w'k	...
Theory of Heat...	2	1	...	...
Theoretical Engineering, Part I	3	2	4	...
Laboratory Practice in Engineering	...	...	...	2
Theory of Construction of Power Machines, Part I...	2	...	...	...
Design of Power Machines, Part I	...	6	...	...
Water-power Machinery	6	...	...	...
Design of Water-power Machinery	...	...	...	8
Theory of Construction of Steam-engines	...	...	6	...
Bridges, Railways, and Hydraulic works	3	...	2	2
Theory of Building Construction for Mechanical Engineers ...	1	...	1	2
Optional: The Hygiene of the workman (1 hour in winter).				
Fourth Year.				
Theoretical Engineering, Part II	2	2	2	...
Laboratory Practice in Engineering	...	...	...	2
Boilers and Furnaces	2	...	...	...
Design of Steam-engines	...	8	...	...
Theory of Construction of Power Machines, Part II	2	...	2	...
Design of Power-engines, Part II	...	...	...	6
Construction of Locomotives	4	...	...	...
Architecture for Mechanical Engineers	2	...	...	2
Chemical Technology, Part II	4	...	...	...
Combustibles and Furnaces	2	...	...	...
Electro-technics for Mechanical Engineers	2	...	3	2
Optional: Theory of Refrigerating Machinery (2 hours in winter) Design of Railway Engines (2 hours in summer).				

16. *Course in Electrical Engineering.*—Mechanical and Electrical Engineering are not bracketed together as the one subject in Munich, but each has its own development. The course for the electrical engineer (*Elektroingenieur*) is as follows :—

PROGRAMME IN ELECTRICAL ENGINEERING, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
First Year.				
Higher Mathematics, Part I ...	6	3	...	...
Higher Mathematics, Part II ...	...	...	4	2
Descriptive Geometry ...	4	4	4	4
Experimental Physics ...	6	...	4	...
General Experimental Chemistry, including outlines of Organic Chemistry ...	...	...	5	...
Technical Mechanics, Part I (Introduction to Mechanics) ...	...	...	4	...
Mechanical Drawing ...	...	4	...	...
(a) *The Arbiturienten of the Classical Gymnasia take:* Algebraical Analysis and Trigonometry ...	4	...	4	...
Optional: Exercises in Algebraical Analysis and Trigonometry (1 hour in winter and summer).				
(b) *The Arbiturienten of the Realgymnasia take:* Algebraical Analysis ...	...	...	4	...
Optional: Exercises in Algebraical Analysis (1 hour in summer).				
Second Year.				
Higher Mathematics, Part III ...	5	3	...	...
Technical Mechanics, Part II (Graphic Statics) ...	3	...	...	...
Technical Mechanics, Part III (Theory of Elasticity) ...	4	...	...	...
Technical Mechanics, Part IV (Dynastics) ...	...	...	3	...
Theory of Construction of Parts of Machines ...	6	...	3	...
Designs of Parts of Machines ...	...	6	...	6
Introduction to the Theory of Construction of Power Machines ...	...	...	1	1
Mechanical Technology, Part I ...	6	...	...	...
Physical Laboratory Practice... ...	...	4	...	4
The Principles of Electro-technics ...	2	...	3	2
Third Year.				
The Mechanical Theory of Heat ...	2	1	...	...
Theoretical Engineering, Part I ...	3	2	4	...
Laboratory Practice in Engineering ...	...	...	...	2
The Theory of Construction of Power Machines, Part I ...	2	...	...	...
Designs of Power Machines, Part I ...	...	6	...	...
Water-power Machinery ...	6	...	...	...
Designs of Water-power Machinery... ...	...	...	...	6
The Theory of Construction of Steam-engines ...	...	...	6	...
The Theory of Electro-technical Measurement ...	2	...	2	...
Electro-technical Laboratory (Practicum I) ...	...	8	...	4
Electro-technical Laboratory (Practicum II) ...	...	...	...	4
Theory and Construction of Measuring Instruments and Calculation of Electricity ...	...	...	2	...
Telegraphy and Telephony ...	2	...	...	...
Theory and Construction of Electrical Machinery, Part I (Continuous-current Machines and Transformers) ...	3	...	...	...
Theory and Construction of Electrical Machinery, Part II (Alternating Current Generators and Synchronomotors)... ...	...	...	4	...
Optional: Hygiene of the workman (1 hour in winter).				
Fourth Year.				
Theoretical Engineering, Part II ...	2	...	2	...
Laboratory Practice for Engineering ...	...	...	...	2
Boilers and Furnaces ...	2	...	...	...
Design of Steam-engines ...	...	8	...	...
The Technics of Lighting and the Construction of Arc-lamps ...	2	...	...	...
Electrical Switches and Regulating Apparatus, etc. ...	1	...	2	...
Electro-technical Laboratory Practice II ...	...	8	...	4
Theory and Construction of Electrical Machinery, Part III (Transformers and Asynchronomotors) ...	3	...	...	...
Design of Electrical Machinery ...	...	4	...	4
Electrical Transmission of Power and Central Installation ...	2	...	2	4
Electrical Railways ...	2	...	1	...
Optional: Theory of Construction of Power Machines, Part II (2 hours in winter and summer).				
Mechanical Technology, Part II (5 hours in summer).				
Metallurgy and Mining (2 hours in winter).				

17. *Courses in Chemistry.*—The following is the course taken by those who desire to become professional chemists:—

PROGRAMME FOR CHEMISTRY, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
First Year.				
Inorganic Experimental Chemistry, including the principles of Physical Chemistry	6	...	...	...
Organic Chemistry	...	...	5	...
Analytical Chemistry, Part I	...	...	4	...
Experimental Physics	6	...	4	...
Mineralogy	...	...	4	...
Crystallography, at the conclusion of the Lectures in Mineralogy	...	...	1	...
Mineralogical Laboratory (Practicum I)	...	...	...	2
Chemical Practicum	...	...	...	10
General and Special Botany	3	...	3	...
Elementary Mechanics	2	...	...	...
Mechanical Drawing	...	2	...	2
Second Year.				
Analytical Chemistry, Part II	2	...	...	...
Geology...	4	...	...	...
Chemical Practicum	...	20	...	20
Physical Practicum	...	4	...	4
Mineralogical Practicum II	...	2	...	...
Crystallographical Laboratory (Practicum)	...	2	...	...
Laboratory Practice in Botanical Microscopy	...	3	...	...
The application of the Microscope in Mineralogy and Geology ...	...	...	...	2
The lower Fungi	...	...	2	...
General Engineering	3	...	4	...
Electrotechnics for Chemists	2	...	3	2
Third Year.				
Chemical Technology, Part I	2	...	...	...
„ „ Part II	4	...	...	...
„ „ Part III	...	...	4	...
Chemistry of Foods	...	...	2	...
Chemical Practicum	...	20	...	20
Fourth Year.				
Chemical Practicum	...	30	...	30
Combustible Materials and the arrangement of Fuel, including the Technical Analysis of Gas	2	...	1	3
Chemical Technology of Water and Carbo-hydrates	3	...	...	...
Optional: The Workman's Hygiene (1 hour in winter).				

18. *Courses in Agriculture.*—The course in Agriculture is characteristically different from that in Agricultural Engineering, as a comparison of the programmes will readily shew. The details of the programme are as follow:—

PROGRAMME IN AGRICULTURE, TECHNICAL HIGH SCHOOL, MUNICH.

Subjects.	Hours per Week.			
	Winter Semester.		Summer Semester.	
	Lectures.	Practice.	Lectures.	Practice.
First Year.				
National Economy	4	...	...	...
Experimental Physics	6	...	4	...
Inorganic Experimental Chemistry, including the principal features of Physical Chemistry	6	...	...	...
Organic Chemistry	...	...	5	...
Mineralogy	...	...	4	...
Crystallography	...	...	1	...
General Botany	5	...	...	...
Special and Systematic Botany	...	...	3	...
Comparative Anatomy of Domestic Animals	3	...	...	...
General Zoology	3	...	4	...
Embryology and History of the development of Domestic Animals	...	...	2	...
Optional: Practice in Chemical Laboratory, Microscopic Practice with Plants, Technical and Plan Drawing.				
Second Year.				
Geology...	4	...	...	...
Science of Agriculture and Chemistry of Soil	5	...	...	...
Meteorology and Climatology	4	...	...	...
Physiology of Animal Organisms, Part I	6	...	...	...
General Agriculture and Horticulture	4	...	...	...
Nutrition of Plants	...	...	2	...
The Theory of the Cultivation of Meadows...	...	...	2	...
Diseases of Agricultural Plants	...	...	2	...
Diseases of Animals	...	...	2	...
Agricultural Implements and Machines	...	...	3	...
The Cultivation of Plants	...	...	1	...
Optional: Physiology of Animal Organisms, Part II; Agricultural Bacteriology, Chemico-agricultural and Agricultural Laboratory Practice, Botanical Microscopy, Zootomic Exercises, Demonstrations on the Agricultural Experimental Fields and on the State Farm, Weihenstephan, Exercises in Valuation, Poultry-breeding.				
Third Year.				
Special Horticulture	2	...	2	...
Nutrition of Agriculturally-important Animals	3	...	...	...
General Theory of Animal Breeding and Regimen...	3	...	...	...
Special Theory of the Rearing of Animals	4	...	4	...
Theory of Agricultural Pursuits	3	...	3	...
Agricultural Technology, Part I (the Fermentation Industries, the Manufacture of Sugar and Starch)	3	...	...	...
Agricultural Technology, Part II (Dairying)	...	...	2	...
The Various Systems of Agricultural Amelioration	...	...	3	...
Agricultural Architecture	...	...	2	...
Optional: Pisciculture, the Cultivation of Moors with demonstrations, Agricultural Systems of Calculation and Theory of Agricultural Taxation, Agricultural Experimental Station, Chemico-agricultural and Agricultural Laboratory Practice, Demonstrations on the Agricultural Experimental Fields and on the State Farm, in the Dairying Institution and also on the Technico-agricultural Demonstration Field in Weihenstephan; Demonstrations in the province of Special Animal Breeding.				

19. *The Doctorate Degree in German Technical High Schools.*—Both in Austria and Germany the degree of Doctor is conferred on those who successfully pass through the advanced technical courses.

To understand the German system it is necessary to bear in mind the thoroughness of the preparation which precedes entrance into the University or the Technical High School. The courses in the University have, for many years past, closed with the degree of Doctor, and it was but natural that the desire should arise for a similar consummation of the studies in the Technical University. A somewhat warm, and sometimes not too seemly a controversy, as to the equality of academic dignity of the courses in the two institutions, viz., the courses in the University and in the Technical High School was waged for a considerable time. This controversy has reached its conclusion. After an acute discussion science and technology have vindicated their claim to be regarded as on the plane of liberal education.

It is now more clearly recognised that all higher subjects may be studied in a liberal way and from the liberal standpoint; and that the disposition to arrogate for certain walks in life a claim to be considered uniquely liberal is without adequate justification. The details of the professions of the church, army, medicine, law, teaching, etc., are not necessarily and often are in no sense liberal. It is the higher elements associated with such professional callings that command respect. The same respect, however, is now widely recognised as belonging also to other higher callings. The professional architect, engineer, chemist, or technologist, is called upon to use the higher mental powers. More and more is it demanded that the professional man shall have a wide outlook upon humanity and human knowledge.

A little reflection will disclose the fact that distinctions which used to be drawn are not only illiberal but unmeaning; and the discussion above referred to has practically settled this question so far as Continental Europe is concerned. And to mark the recognition of the academic prestige of scientific and technical courses the doctorate is now conferred on those who satisfactorily pass through their studies.

It will be of interest, therefore, to give an account of the regulations under which the degree is given.

20. *Doctorate Regulations, Munich Technical High School.*—The following is a free translation of the conditions under which the doctorate is conferred :—

REGULATIONS FOR THE DOCTOR'S DEGREE IN THE ROYAL BAVARIAN TECHNICAL HIGH SCHOOL, MÜNCHEN.

Section I.

The conferring of the degree of Doctor of the Technical Sciences is dependent on the following conditions :—

(1) The production of the Certificate of Maturity of a German *Gymnasium* or *Realgymnasium*, or of a Bavarian Industry School (*Industrieschule*), or a German *Oberrealschule.*

Those Maturity Certificates of other schools which are allowed as of equal value in other respects to those abovenamed, are declared by the Royal Home Secretary (*K. Staatsministerium*) for Church and School Affairs. (*Kirchen und Schulangelegenheiten*).

(2) The proof of having successfully passed a diploma examination in accordance with the regulations issued by the Royal Home Secretary for Church and School Affairs.

If a diploma is not possessed the proof of having successfully passed a Government examination or a Teacher's examination, may be substituted.

Respecting the possible equalisation of other examinations, further arrangements will be made by the Home Secretary for Church and School Affairs.

(3) The presentation of a dissertation (Abhandlung) in German on a scientific subject, giving evidence of the candidate's ability for independent scientific research. The subject must be one selected from those studied in the Technical High School, in so far as they relate to the technical sciences, or constitute their basis, or are subsidiary thereto.

Work undertaken for the diploma cannot be submitted as the doctorate dissertation.

(4) The passing of an oral examination.

(5) The payment of an examination-fee of 240 marks (£12).

Section II.

The application for the degree must be addressed in writing to the "*Directorium*" of the Technical High School, to which must be attached the following documents :—

(*a*) A sketch of the course of life and education of the candidate.

(*b*) The written documents by which the fulfilment of the conditions mentioned in Section I, Nos. 1 and 2, is to be accomplished.

(*c*) The dissertation ready for the press, with the declaration on oath that it is the candidate's own composition, and is independent of all sources of help.

(*d*) An official certificate of good conduct.

At the same time half the examination-fee must be paid to the Treasurer of the High School.

Section III.

The "*Directorium*" transmits the application, where there is no reason of doubt, to the "*Kollegium*" of that teaching department where the subject discussed is treated, with a request to arrange for an Examination Committee composed of a president, a referee, and a co-referee. In special cases a *Dozent*, who does not belong to the "*Kollegium*" of the department, or a Professor or *Dozent* of another department, may be appointed to act on the committee.

Section IV.

Section IV.

After the examination of the subjects by the committee, the president gives a written report of the proceedings to the departmental "*Kollegium*," which report, together with the dissertation and the judgment of the referee and the co-referee thereon, is to be placed before all the members of the departmental "*Kollegium*" in succession. Hereupon the "*Kollegium*" resolves in session as to the acceptance of the dissertation, and decides upon a suitable period for the holding of the oral examination.

The remainder of the examination-fee should be paid before the oral examination.

Section V.

The "*Directorium*," and all the professors and "*Dozenten*" of the department concerned, are invited to attend the oral examination. Every teacher of a German Technical High School or University has also the right to attend.

The oral examination, which is individual, is conducted by the President. It must be at least of one hour's duration, and include the subjects treated in the dissertation, having regard to their respective provinces.

Section VI.

Immediately after the termination of the examination, the departmental *Kollegium* decides in session upon the report of the Examination Committee, whether and with which of the three judgments—viz., "Passed" (*Bestanden*), "Passed well" (*Gut bestanden*), "Passed with distinction" (*Mit Auszeichnung bestanden*)—the candidate has passed, and whether the conferring of the degree on him of Doctor of the Technical Sciences (*Doktor der technischen Wissenschaften*) (Doctor-Engineer, *Doktor-Ingenieur*) is to be recommended to the *Directorium*. The latter, at its next meeting, passes a resolution on the motion of the *Kollegium*.

Section VII.

The resolution of the "*Directorium*" is communicated to the candidate by the Director. The diploma of doctor is, however, handed over to him only after he has presented 200 copies of the dissertation. Before the issue of the diploma the candidate is not entitled to be called Doctor of the Technical Sciences or Doctor of Engineering.

The copies of the dissertation presented must bear a distinct title-page, on which is expressly stated the title of the treatise, under the signatures of the referee and co-referee, thus: "Dissertation accepted by the Technical High School at München for the degree of Doctor of Technical Science" (Doctor of Engineering).

On the motion of the Departmental *Kollegium*, the *Directorium* can require the candidate to make alterations in his work before publication.

Section VIII.

The diploma is drafted according to a given plan in the name of the *Directorium*, and signed by the Director. A copy of this is posted up for fourteen days on the notice-board of the *Directorium*.

The names of the graduates will be published half-yearly in the Ministerial Journal for Church and School affairs, and yearly in the Official Gazette.

Section IX.

With regard to the examination fees, additional modifications may be made.

Section X.

Poor but particularly meritorious candidates may, by way of exception, be exempted by the *Directorium* from payment of half the examination fee on the recommendation of the *Kollegium*.

Section XI.

The intelligence is to be conveyed to all the Technical High Schools of the German Empire of the failure or rejection of a candidate at an examination.

Only one other opportunity of passing the examination is allowed the candidate, and that not before the expiration of a year. This latter, moreover, is only recognised if the first unsuccessful examination was held in one of the other high schools.

Should the first written examination in the High School of München be successful, and the dissertation be accepted, but the oral examination result in failure, only the latter need be repeated, and the half only of the examination fee again paid.

Section XII.

Men who have furthered the cause of technical science, and thus rendered distinguished and generally-recognised service, may be the recipients of the degree of Doctor of the Technical Sciences in any honorary way on the unanimous recommendation of the *Kollegium*, and through the unanimous decision of the *Directorium* acting on the information of the other high schools of the German Empire.

The preceding order respecting graduation was ratified by the Royal Home Secretary for Church and School Affairs on the 10th January, 1901, nr. 24,509.

Directorium of the Royal Technical High School,

(Signed) Dr. W. Dyck.

The above gives a general idea of the conditions under which the doctorate is conferred.

21. *Concluding Remarks.*—The preceding account should give a fair idea of the type of instruction afforded by the Technical High Schools of Germany. The Commissioner obtained similar information in regard to the Technical High Schools of Aachen (Aix-la-Chapelle), Darmstadt, Hanover, Karlsruhe, but time will not permit of its presentation.

In every instance, these schools shew that they are really *technical universities* of the highest order. The efficiency of the teaching is ensured by the high calibre of the men accepted on the professorial staffs, and by the complete equipment in the way of laboratory apparatus and material, and in the cabinets and museums, at their disposal.

Although the courses are orientated in regard to practical requirements of technical and professional education, they are, nevertheless, *liberal* throughout, and are on a very high plane. The teaching accessories are very fine; the lecture-theatres well-arranged for demonstration, and in the more modern buildings the convenience of their disposition is sometimes ideal. For example, the seats are disposed in curves round the lecturing table; in vertical section the seats lie in a parabolic curve, so that the acoustic properties are excellent. The roof is so constructed that it may be rolled over in such a way as to exclude all light, being actuated by an electro-motor; at the same time all other sources of natural light are simultaneously shut off. The demonstration preparing-room is most conveniently disposed so that the apparatus can slide into the lecture-theatre.

With populations large enough to carry both the ordinary and technical University, there is probably great advantage in the separation of the two. There can be no doubt that technical instruction of the European school is of the highest character. Technical high schools in Europe possess advantages which make it impossible at present for the University of this State to compete with them in the professional or technical courses. Our laboratory equipments are not adequate, nor does the organisation of the teaching allow of the requisite degree of specialisation.

CHAPTER XXXIII.

CHAPTER XXXIII.

The Federal Polytechnic at Zurich, Switzerland.

[G. H. KNIBBS.]

1. *Introduction.*—The Federal Polytechnical School of Switzerland, at Zurich (*Eidgenössische polytechnische Schule*) is one of the most renowned polytechnica or *technical high schools* of the world. It has for a considerable time been magnificently equipped, but that equipment is continually being added to and kept well up to date. At the time of the Commissioners' visit it was evident that there had been a considerable number of recent additions, and very large additions were in progress. Some reference will be made to this matter later.

To properly understand a school of this grade it is important to bear in mind that it is really a *Technical University*, and is *toto coelo* different from what is often understood by the term "polytechnic," viz., a place where a large variety of technical arts are taught on an elementary or secondary grade.

The requirements in entrance are such as to assure profitable attendance, and the courses are definitely organised so as to thoroughly qualify the student in whatever branch of technical learning he takes up.

2. *Entrance and General Conditions.*—The academic year commences about 6th October and the lectures on about 14th October, and closes about the middle of March, the winter semester closing about 21st March. The summer semester opens about 14th April.

Applicants furnish:—

(1.) Written application, stating name, place of home, subject, and courses he wishes to take.
(2.) Written consent of parents or guardians, with their addresses.
(3.) Proof of age of 18 years.
(4.) Testimonial of character (if not already in certificates of previous studies).
(5.) Certificates of former studies, of practical activity if any. These must be in German, French, or Italian, or must be officially translated.

Applicants must either possess the maturity certificate (*certificat de maturité*, maturitätszeugnis) of a Swiss middle school which stands in official relation with the Polytechnicum, or submit to an entrance examination, commencing about the 6th October. The results are declared about the 13th of the month. Students have to "inscribe" their names, and they receive an attendance card (*Legitimationskarte*) authorising their attendance at lectures.

Irregular students may attend lectures, and entrance may take place at any semester. Even for these, however, an entrance examination is necessary, except in what might be called the free faculties, viz., the "General, Philosophical, and State Economy" division and the "Military Science" division. The irregular students are subject to the same general regulations in regard to the repetitions, examinations, and written work, unless, however, they have otherwise "absolved" themselves by complete higher technical studies. Men of mature years are also relieved of strict conformity to the obligations in this respect.

Students of the Zurich University who desire to attend one of the free faculties have merely to apply for an attendance card.

Visiting (*hospitiren*) is allowed for eight days at most, but this is subject to the permission of the particular professor or instructor in the course attended.

To some extent a dispensation relieving the students from attendance in particular subjects is permitted, or they may be allowed to exchange subjects in one division for subjects in another. In such cases, however, the sufficiency of knowledge in the subject omitted is taken into account. In the various faculties, from the third year onward, a selection of the material of instruction within the limits of their year courses is permitted to the regular students. The selected subject naturally becomes obligatory.

In the Agricultural division landed proprietors of mature years, who desire to follow some special direction of study, may be relieved from strictly conforming to the ordinary yearly programme, and may even make an individual selection among the courses.

Students may pass from one faculty into another only at the beginning of the months of October and April, and then only with the consent of their parents or guardians.

Every regular student must in each semester attend at least one lecture in the free Faculty division.

Students are permitted to work in the rooms for drawing and in the laboratories and the workshops so long as it may be done without artificial light in the winter semester. In the summer semester they may work up to 7 o'clock in the evening. On Saturdays the laboratories, etc., are closed at 4 o'clock and remain closed throughout Sunday.

In the first five divisions, viz., Architecture, Engineering, Mechanical Technics, Chemical Technics, and Agriculture and Forestry, the necessary excursions for elucidating the instruction are made. The professors of Botany and Zoology also take their students out on field excursions. At the close of each semester during the entire course every student in each Faculty must obtain a certificate (*matrikelauszug*), shewing his attendance and his industry in the obligatory subjects.

Students who desire to abandon their studies indicate the same to the director and return their attendance and library cards, but are permitted to make this abandonment only with the consent of their parents or guardians. They receive a certificate as to the courses attended and as to their conduct. The *matrikelauszüge* testify as to their diligence and industry.

Students

Students who complete their courses, receiving a leaving certificate (*abgangszeugnis*), shewing the average marks for the obligatory subjects, as well as for the free subjects, and shewing also the conduct of the students. At the close of the courses in each division the students undergo an examination for the diploma.

3. *Fees for Various Courses.*—The fees in the Polytechnicum are given to indicate the cost of the highest grade of instruction in Switzerland, and are as shewn hereunder. It may be mentioned that 25 francs may be taken as equivalent to £1, and, for the sake of brevity, the number will indicate francs and the word "franc" will be omitted.[1] The following are the fees:—

	Fr.
Entrance—	
Inscription fee paid on application to enter	10
Entrance—Examination fee	20
Yearly—	
School fee, yearly	150
Insurance against sickness and accident	6
Library and reading-room fee...	5

The following fees are paid each semester by regular students and auditors:—

Subjects.	Dues. Students and Auditors.	Fees. Auditors.
	Fr.	Fr.
Analytico-chemical "Praktikum,"[2] 17-24 hours—Winter ...	50	60
,, ,, ,, ,, Summer ...	45	60
,, ,, ,, daily—Advanced students ...	60	60
,, ,, ,, Winter ...	50	60
Technico-chemical Praktikum, 16-24 hours—Summer ...	45	60
,, ,, ,, daily—Advanced students ...	60	60
,, ,, ,, Winter ...	50	60
Pharmaceutico-chemical Praktikum, 12 hours—Summer ...	45	60
Pharmacognostical Exercises for advanced students ...	40	30
Exercises in the investigation of foodstuffs ...	30	30
Agricultural Chemical Praktikum, 4 hours ...	20	20
,, ,, ,, 8 ,, ...	40	40
,, ,, ,, daily—Advanced students ...	60	60
,, ,, ,, two hours ...	10	10
Chemical Praktikum for Division II and III, 4 hours ...	20	20
Electro-chemical Praktikum, 4 hours... ...	20	20
,, ,, ,, 15 hours... ...	75	60
Physico-chemical Praktikum, daily ...	50	60
Thermo-chemical Praktikum (in Winter), one half-day ...	10	10
Application of physical methods in chemistry (in Summer), one half-day ...	10	10
Physical Praktikum, 4 hours ...	20	20
,, ,, 6 hours ...	30	30
,, ,, 8 hours ...	40	40
,, ,, 12 hours ...	50	60
,, ,, daily—advanced students ...	80	60
Electro-technical Praktikum, 4 hours ...	20	20
,, ,, ,, 8 hours ...	30	40
,, ,, ,, 16 hours... ...	40	60
Exercises in the Hydraulic division of the Mechanical Laboratory, half-day ...	15	20
,, ,, Thermo-dynamic division of the Mechanical Laboratory, half-day	15	20
Technological Praktikum ...	15	20
Systematical-botanical Praktikum, 4 hours ...	10	15
,, ,, ,, 8 hours ...	20	30
Mineralogical-petrographical Praktikum—beginners ...	10	10
,, ,, ,, advanced students ...	20	30
Laboratory of the Mineralogical-petrographical Institutes... ...	30	30
Zoological Praktikum, for beginners ...	25	25
,, ,, ,, advanced students ...	50	No attendance.
,, ,, ,, farmers and foresters ...	5	10
Anthropometrical anatomical exercises ...	......	20
Advanced anthropometrical praktikum ...	......	50
Bacteriological Praktikum, for beginners ...	15	20
,, ,, ,, advanced students ...	25	40
Exercises in the Bacteriological Laboratory, for farmers, 4 hours... ...	10	20
,, ,, ,, ,, for dairymen, 12 hours ...	25	40
Photographical Praktikum ...	15	10
Metal workshop... ...	10	No attendance.
Modelling workshop ...	5	20

[1] Hence, multiply by 4 and mark off 1 point for results in pounds sterling.
[2] A number of students systematically working under guidance is a "Praktikum."

At

At the beginning of every semester, every student working in the analytico-chemical, technico-chemical, and electro chemical laboratories are required to pay a security fee (kaution) of 50 francs for the use of apparatus, against which are charged any breakages he may make. For the candidates for the diploma, that is, for the seventh semester, this sum is raised to 100 francs. After allowing for breakage, the balance is returned.

The dues for the free subjects are included in the fee of 150 francs, but for lectures which are not obligatory, and are given by the honorary professors and "*Privatdozenten*," a special fee of 5 francs per weekly hour in the semester is charged.

"Auditors" who inscribe their names for a particular laboratory have to pay $1\frac{1}{2}$ francs as a premium in case of accident.

4. *Schools in the Zurich Polytechnicum.*—The Zurich Polytechnicum is divided into the following departments, viz.:—

I. *School of Architecture.*

II. *Engineering School* (Civil Engineering).

III. *Mechanico-Technical School* (Mechanical Engineering).

IV. *Chemico-Technical School* (School of Chemical Technology).—This has two branches, viz.:—(a) Technical or technological section: (b) Pharmaceutical section.

V. *Agricultural and Forestry Division*, with its three branches, viz.:—(a) Forestry school; (b) Agricultural school; (c) Agricultural Engineering school.

VI. *School of Special Teachers in Mathematical and National Science Subjects.*—This has two branches:—(a) Mathematico-physical section; (b) Natural Science section.

VII. *General Philosophy and State-Economy Division.*—This has two branches, viz.:—(a) Mathematics and Physics, Natural Science, and technical subjects; (b) Languages and Literature; Historical and Political Sciences, Art.

VIII. *Military Science Division*, with two branches, viz.:—(a) Course for general students; (b) course for officers specially.

The course in Agriculture is elsewhere outlined in full. The other departments will be detailed hereunder.

5. *Zurich School of Architecture.*—The course in Architecture lasts seven semesters, that is to say, three and a half years, and provides both the scientific and the artistic elements of training. The Polytechnic has the necessary equipment for both. The order of development is as indicated in the following curriculum, viz.:—

I.—SCHOOL OF ARCHITECTURE (7 Semesters).

Subject.	Hrs. per week.
Ist Year.—1 and 2nd Semesters.	
Higher Mathematics ...	5
Exercises ...	2
Descriptive Geometry ...	2
Exercises ...	4
Building Construction ...	3
Exercises ...	6
Architectural Drawing ...	6
Sketching Exercises ...	2
Ornamental Drawing from Plaster Models...	3
Modelling in Clay and Plaster ...	4
History of Ancient Art ...	4
II Year.—3rd and 4th Semesters.	
Theory of Architectural Forms, Part I, with Exercises ...	3
Exercises in Designing ...	6
Ornament and Decoration ...	4
Building Construction ...	3
Exercises ...	6
Statics of Architecture ...	3
Exercises ...	2
Theory of Building Construction. Part I.	2
Perspective ...	1
Drawing from Models ...	6
Building Sanitation ...	2

Subject.	Hrs. per week.
III Year.—5th and 6th Semesters.	
Architecture (Renaissance), with Sketching Exercises ...	3
Exercises in Design ...	8
Architecture (Mediæval), with Sketching Exercises ...	3
Exercises in Design ...	8
Ornamental and Decorative Work, with Exercises in Design ...	4
Interior Work ...	2
Theory of Building Construction, II Part ...	2
Examples in Iron Construction ...	3
Model Drawing ...	6
IV Year (half-year).—7th Semester.	
Architecture (Renaissance) ...	2
Exercises in Design ...	8
Sketching Exercises (Surveying Excursions)	2
Architecture (Mediæval), with Sketching Practice ...	3
Exercises in Design ...	8
Ornamental and Decorative Work, with Exercises in Design ...	4
Traffic Laws (Part II.), with Repetition ...	3
Law relating to Technics, viz., to Building, Railway and Water Rights ...	2

6 *The Zurich School of Engineering.*—The course in engineering also lasts seven semesters, three and half years. The "repetition" system is excellent; it ensures the matter being thoroughly mastered. It may also be described as revision and recapitulation.

II.—SCHOOL OF ENGINEERING (7 Semesters).

Subjects.	Hrs. per week.
I Year.—1st and 2nd Semesters.	
Differential Calculus (German)	4
"Repetition"[1] (in groups)	1
Exercises "	2
Differential Calculus (French)	4
Repetition	1
Exercises	2
Descriptive Geometry	4
Repetition (in groups)	1
Exercises	4
Analytical Geometry	4
Repetition (in groups)	1
Architecture and Civil Engineering	3
Exercises in " "	4
Drawing of Plans (in groups)	2
Chemistry	2
Repetition	1
II Year.—3rd and 4th Semesters.	
Differential Equations	4
Exercises in "	1
Theory of Differential Equations	4
Repetition	1
Mechanics, II Part	4
Repetition (in groups)	1
Exercises (in groups)	2
Graphical Statics, I Part	2
Exercises in "	2
Repetition	1
Physics	4
Repetition	1
Engineering	4
Exercises in Engineering	4
Technical Geology	3
Repetition	1

Subjects.	Hrs. per week.
III Year.—5th and 6th Semesters.	
Iron Bridges	4
Exercises in Iron Bridges	6
Repetition	1
Flow of water in rivers and canals	1
Water supply and canalisation of municipal districts	2
Foundations	2
Exercises in design of foundations	5
Surveying	5
Repetition	1
Exercises in Surveying (in groups)	2
Technology of materials of construction, II. (iron and steel)	2
Repetition	1
Electric transmission of power and Electric Lighting	3
Repetition	1
Elementary Astronomy	3
Exercises in "	2
Technical Geology	3
Repetition	1
IV Year.—7th Semester.	
Highway and Railway Construction	5
Exercises in Design	6
Railway Engineering	4
Repetition	1
Water supply and canalisation of municipal districts	2
Elevated structures in iron	2
Exercises in design of above	3
Electric Signal Apparatus for Railways	2
Traffic Laws (Part II) with repetition	3
Law relating to Technics, viz., to Buildings, Railways, and to Water-rights	2
Elements of National Economy	3
Repetition	1
Political Economy	2
Repetition	1
Geodesy, with repetition	2
Practical Geodesy	2
Topographical Drawing	2

In connection with the above it may be pointed out that the infinitesimal calculus is taken in the first year, and the general theory of differential equations in the second. This implies sufficient preparation in the middle school, which is very thorough in Switzerland.

7. *The Zurich Mechanico-technical School.*—This school is for mechanical engineering and mechanical technology. The course is a somewhat severe one, as will be obvious by reference to the programme given hereunder. Although the programme is set forth separately, a little examination will shew that parts are identical with the preceding programme, that is, certain elements are common to both courses. The total courses occupy three and half years, or seven semesters, and cover a very wide range.

The

[1] Repetition is recapitulation and revision.

The details are as shewn hereunder :—

III.—MECHANICO-TECHNICAL SCHOOL (7 Semesters).

Subjects.	Hrs. per week.
I Year.—1st and 2nd Semesters.	
Differential Calculus (in German)	4
"Repetition" (in groups)	1
Exercises in	2
Differential Calculus (in French)	4
Repetition „	1
Exercises in „	2
Descriptive Geometry	4
Repetition (in groups)	1
Exercises in same	4
Descriptive Geometry	4
Repetition „	1
Exercises „	4
Analytical Geometry...	4
Repetition (in groups)	1
Machine Drawing (lectures)...	1
" " (practice)	4
Chemistry	2
Repetition	1
II Year.—3rd and 4th Semesters.	
Differential Equations	4
Exercises in "	1
Theory of Different Equations	4
Repetition	1
Mechanics, Part II.	4
Repetition (in groups)	1
Exercises (in groups)	2
Physics	4
Repetition	1
Elements of Machine-making	5
Repetition	1
Exercises in Design...	10
Mechanical Technology, Part II (metal work)	2
Repetition (in groups)	1
Milling (optional)	2
Practical technology (optional)	4

Subjects.	Hrs. per week.
III Year.—5th and 6th Semesters.	
Theoretical Engineering, II Part. Theory of Heat and Steam-engines	4
Exercises "	3
Construction of Steam-engines, I Part (Valves and Regulators)	4
Exercises in „	2
Gas Engines (Introductory)...	1
Practice in the Calorimetric Division of the Mechanical Laboratory	½ day
Hydraulic Motors and Pump, II Part. ...	4
Practical Work	1
Exercises in Design	12
Exercises in the Hydraulic Division of the Mechanical Laboratory	½ day
Principles, Apparatus and Instruments of Measuring of Electro-technics	4
Mechanical Technology, IV. (Spinning and Textile machinery)	2
Milling	2
Industrial Sanitation	2
IV Year.—7th Semester.	
Exercises in Iron Construction	3
Electro technical Laboratory ...	8 or 16
Boilers and Steam-engine Design	2
Machine Construction and Designs of complete steam installations	6
Practical Work in the Calorimetric Division of the Mechanical Laboratory ...	1½ day
Design of Installations in Factories... ...	4
Selected chapter concerning Hydraulics of every description	2
Practice in the Hydraulic Division of the Mechanical Laboratory... ...	½ day
Dynamo Design	2
Machine Construction	6
Electrical Central Stations, II Part. ...	2
Exercises and Designs	3
Alternating Currents and Alternating Current Motors	2
Experimental Research in Alternating Currents and Motors	4

8. *Zurich Chemico-Technical School.*—The main section of this school deals with chemical technology viewed from a very broad standpoint, as is obvious from the fact that it includes physical as well as inorganic and organic chemistry, general and applied electro-chemistry, gas and food analysis, bacteriological work, bleaching, dyeing, the chemistry of dyes, microscopy, technological botany and general electro-technics, etc. This main course last seven semesters (three and a half years).

The pharmaceutical section lasts only two years, viz., four semesters ; and while obviously an excellent course for its purpose, it can hardly be compared in academic dignity with the course in general chemical technology. A more extended course in pharmaceutical chemistry is obviously unnecessary, bearing in mind the restricted area of pharmacology.

The following are the details of the courses in the chemico-technical school :—

IV.—CHEMICO-TECHNICAL SCHOOL.

(A.) TECHNICAL SECTION (7 Semesters).

Subjects.	Hrs. per week.
I Year.—1st and 2nd Semesters.	
Higher Mathematics...	5
Exercises in „	2
Inorganic Chemistry	6
"Repetition"	1
Analytical Chemistry, I Part.	2
"Praktikum" for Analytical Chemistry ...	16
Mineralogy	4
Repetition	1
Mechanics and Engineering	4
Repetition	1

Subjects.	Hrs. per week.
II Year.—3rd and 4th Semesters.	
Inorganic Chemical Technology	4
Repetition	1
Heating, etc.	2
Organic Chemistry, Part II. (Benzene Derivatives)	2
Repetition	1
Praktikum for Technical Chemistry ...	16
Physics	4
Repetition	1
Praktikum for Physics for beginners ...	4
Engineering	2
Repetition	1
Exercises in Design	4

III Year.

Subjects.	Hrs. per week.
III Year.—5th and 6th Semesters.	
Bleaching, Dyeing and Dyes	4
Repetition	1
Metallurgy	2
Repetition	1
Praktikum for Analytical Chemistry or ...	24
Praktikum for Technical Chemistry ...	24
General Botany with repetition	4
General Geology with repetition	5
Analysis of Gas with exercises	1
Analysis of Foods „ „	2
General Electro-Chemistry	2
Praktikum for Electro-Chemistry for advanced students	15
Physical Chemistry	2
Industrial Fittings and Buildings	2

Subjects.	Hrs. per week.
III Year.—5th and 6th Semesters—continued.	
Exercises in Design	2
Industrial hygiene	2
Bacteriological exercises for beginners ...	5
„ „ for advanced students,	daily
IV Year.—7th Semester.	
Praktikum for Analytical Chemistry or ...	24
Praktikum for Technical Chemistry ...	24
Praktikum for Electro-Chemistry for beginners	4
„ „ „ for advanced students	15
Exercises in Microscopic Work	2
Technological Botany, I. (Fibres and their strength.)	2
Electro-technics	2
Elements of National Economy	3
Political Economy	3

(B.) Pharmaceutical Section—(4 Semesters).

Subjects.	Hrs. per week.
1st Year.—1st and 2nd Semesters.	
Inorganic Chemistry	6
Repetition	1
Analytical Chemistry—1st Part	2
Praktikum for Analytical Chemistry ...	16
Mineralogy	4
Repetition	1
General Botany	3
Repetition	1
2nd Year.—3rd and 4th Semesters.	
Physics	4
Repetition	1
Praktikum for Physics for Beginners ...	4
Praktikum for Pharmaceutical Chemistry	12

Subjects.	Hrs. per week.
2nd Year.—3rd and 4th Semesters—continued.	
Organic Chemistry—2nd Part, Benzene derivations	2
Repetition	1
Pharmaceutics	5
Toxicology	2
Analysis of Foods with exercises	2
Technical Botany, I. (fibres and their strength)	2
Microscopical Inspection of Pharmaceutical Drugs	2
Pharmaceutical Exercises for Advanced Students	daily
Pharmaceutical Botany with Repetition ...	3
Bacteriological Exercises :—	
For Beginners	5
For Advanced Students	daily
Exercises with the Microscope	2

For Students of Divisions IV (A), IV (B), and VI (B) who intend to become chemical experts in the examination of alimentary substances, the following lectures and exercises are also taken :—

Microscopic Exercises in the Examination of Alimentary Products	2 half-days.
Praktikum for Judicial Chemistry	4 half-days.
Systematic Botany, I.	1 day.
Bacteriological Exercises	4 half-days.
Hygienic Exercises and Excursions	?
Hygiene of Foods	1 day.

9. *Zurich School for Special Teachers in Mathematical and Natural Science Subjects.*—This is the sixth division or department of the Zurich School. It will be observed that Division V has been omitted, the reason being that the agricultural and forestry teaching is dealt with elsewhere in the report.

In this division, no general programme of instruction has been organised, the idea is to take up certain lectures in such a way as to profit for the end in view, and students may participate in this course and in others.

The real foundation for specialisation as teachers is a plan of studies which, in a complete normal programme, is of four years' duration.

Participation in seminarial exercises takes place as a rule in the 3rd and 4th years for physics, and in the three last semesters for mathematics.

The two branches " sections " are (1) the mathematico-physical and the (2) natural science. In regard to the latter, the normal programme has alternative three or four year courses. The seminarial exercises are taken in the third year. Specialisation, as a rule, takes place in a chemico-physical direction in botany and zoology, or in mineralogy and geology.

The

The details of the courses are as hereunder :—

VI. DIVISION.

SCHOOL FOR SPECIAL TEACHERS IN MATHEMATICAL AND NATURAL SCIENCE SUBJECTS.

Mathematico-Physical Section.

Subjects.	Hrs. per week.
1st Year.	
Differential Calculus	4
Repetition and Exercises in Groups	3
Differential Calculus (in French)	4
Repetition and Exercises	3
Analytical Geometry	4
Repetition	1
Descriptive Geometry	4
Repetition and Exercises	5
Descriptive Geometry (in French)	4
Repetition and Exercises	5
2nd, 3rd, and 4th Years.	
Differential Equations	4
Exercises	1
Theory of Differential Equations	4
Repetition	1
Geometry of Position (I)	4
Geometry of Position (II)	2
Mathematical Seminary	2
The Theory of Functions, I	4
Algebraical Numbers	2
Mechanics, II. Part	4
Repetition and Exercises	3
Theory of Linear Differential-equations	2
Surveying	5
Repetition and Exercises	3

Subject.	Hrs. per week.
2nd, 3rd, and 4th Years—continued.	
Geodesy, with repetition	2
Geodetical "Praktikum"	2
Application of Geodetical Lines to Geodesy	2
Theoretical and Experimental Optics	2
Physical "Praktikum" for Beginners	8
Scientific Work in the Physics Laboratories	4, 8, 24
Physics	4
Repetition	1
Principles, Apparatus and Methods of Measurement in Electro-technics	4
Alternating-current Systems and Alternating-currents and Motors	2
Electro-mechanics	2
Laboratory for Electro-technics	8 or 16
Scientific Work in the Physical Laboratory	8, 12, 24
Experimental Research in alternating Currents and Motors	4
Elementary Astronomy	3
Exercises therein	2
Theory of Eclipses and Kindred Phænomena	1
Logic	1
Introduction to the reading of Philosophical Works	1
Theoretical Pædagogy	2

B. Natural Science Section.

Subjects.	Hrs. per week.
I. Year Course.	
Higher Mathematics	5
Exercises	2
Inorganic Chemistry	6
Repetition	1
Analytical Chemistry, I Part	2
"Praktikum" for Analytical Chemistry	12–16
Mineralogy	4
Repetition	1
General Botany	3
Repetition	1
II and III Years.	
"Praktikum" for Analytical Chemistry	24
"Praktikum" for Technical Chemistry	24
Organic Chemistry, II Part (benzene derivatives)	2
Repetition	1
Heating, etc.	2
Gas Analysis with exercises	1

Subjects.	Hrs. per week.
II and III Years—continued.	
Analysis of Foods with exercises	2
Physical Chemistry	2
Application of Physical Methods to Chemistry	½ day
Complete "praktikum" in Physical Chemistry for advanced students	daily
General Electro-chemistry	2
Chemical Dynamics (Kinetics)	1
"Praktikum" for Electro-chemistry (advanced students)	15
Physics	4
Repetition	1
Theoretical and Experimental Optics	2
"Praktikum" for Physics for beginners	8
Scientific Studies in the Physics Laboratory	4, 8, 24
General Geology	4
Repetition	1
The History of the Origin of Man	1

II.

Subjects.	Hrs. per week.
II and III Years—continued.	
Seminarial Exercises	1
Exercises in the Determination of Minerals	3
"Praktikum" for Mineralogical Petrography (beginners)	2
"Praktikum" for Mineralogical Petrography (advanced students and introduction to independent research)	daily
Exercises in the Laboratory of the Mineralogical Petrographical Institute ...	daily
Pathology of Plants, with Repetition ...	1
Exercises in Microscopy	2
Complete Practice in the Physiology of Plants	daily
Technical Botany (fibres and their strength)	2
Mountain Flora	1
"Praktikum" for Systematic Botany ...	4 & 8
{ Comparative Anatomy	7
{ Repetition	1
Selected Chapter of the most recent Zoological Researches, III Series ...	1

Subjects.	Hrs. per week.
II and III Years—continued.	
Complete "Praktikum" for Comparative Zoology, Anatomy, and introduction to independent research.	daily
Natural History of the Human Race at the present time	1
Industrial Hygiene	2
Bacteriological Exercises for beginners ...	5
Bacteriological Exercises for advanced students	daily
Meteorology and Climatology	3
The Principal Atmospheric Phænomena (Physical Geography, III Part).	2
Geography of Switzerland	2
The Countries of North America	1
The Elements of Astronomy	3
Exercises therein	2
Logic	1
Introduction to the Reading of Philosophical Works.	1
Theoretical Pædagogy.	

The above courses are clearly designed to afford an opportunity of becoming specially qualified in various subjects, so as to be equipped for the higher grades of teaching.

10. *Zurich General Philosophy and State Economics School.*—Division VII of the Zurich School includes a great variety of general subjects, included under two great branches as already indicated.

Some of these courses are highly specialised, as a reference to their titles will shew. Such a subject as "Technical Botany" deals with fibres and their strength and general qualities, modes of identifying them, their preparation, and so on.

The detailed courses are as follow :—

VII. GENERAL PHILOSOPHICAL AND POLITICAL TECHNOLOGICAL ECONOMY DIVISION.

(A) MATHEMATICAL, NATURAL SCIENCE AND TECHNOLOGICAL LECTURES IN PART SUPPLEMENTARY TO THE PROFESSIONAL SCHOOL PROGRAMMES.

[1] *Mathematics and Physics.*

Subjects.	Hrs. per week.
Geometrical Introduction to Graphical Statics	2
Slide-rules with Exercises	1
Descriptive Geometry	2
Geometry of Position	4
Selected branches of Mechanics	2
Theory of Linear Differential Equations ...	2
Theory of Central Projection with application to practical perspective...	2
Projective series and pencils, with application to the theory of Construction of Conic Sections...	2

Subjects.	Hrs. per week.
Solution of General Equations of the 3rd and 4th degree, and of any Equations whatsoever by approximation	2
The general Theory of Elasticity	4
Geometry of Position (in French)	2
The projection of Maps	1
Application of the Geodetic Line in Geodesy	2
Theoretical and Experimental Optics ...	2
{ The Elements of Astronomy...	3
{ Exercises therein	2
Theory of Eclipses and of allied phænomena	2

[2] *Natural Science.*

Subjects.	Hrs. per week.
Examination and purification of water for technical purposes, viz., for the feeding of boilers	1
Physico-chemical "Kolloquium"[1] (gratis)	1
History of the development of domestic animals (gratis)	1
Fertilisation, hybridisation, etc., of plants	1
The principal atmospheric phænomena (Physical Geography, III Part)	2
Geography of Switzerland	2
The countries of North America	1
Mineralogy	4
Exercises in the determination of minerals	3
Praktikum for Mineralogical-Petrography (for beginners)	2
Praktikum for Mineralogical-Petrography for advanced students and introduction to independent research	daily
Exercises in the laboratory of the Mineralogical-Petrographical Institute	daily
Chemical inspection of foods, and the composition of foods	daily
Technical Botany, I (fibres and their strength)	2
General Geology	4
The history of the Origin of Man	1
Fishing and Fish-culture	2
Zoological Praktikum for Farmers and Foresters	2

Subjects.	Hrs. per week.
History of the reproduction and propagation of domestic animals	1
Natural history of the existing human race	1
Comparative Anatomy	7
Repetition	1
Selected chapter of the most recent zoological phænomena. II Series	1
Chemical Dynamics (Kinetics)	1
Physical Anthropology (the bodily variations in the human race), with demonstrations	2
Repetition	1
Anatomy of Man, with special demonstration lessons	3
Anatomical exercises and repetitions supplementary to the lectures thereon	2
Anthropological course for beginners	2
Complete Anthropological "Praktikum" (preparatory exercises and introduction to independent research)	daily
Flora of the Arctic Regions (gratis)	1
Culture, etc., of Agricultural Plants	1
Fermentation and its operations	1
Alpine Flora	1
Systematic description of the insecta (gratis)	2
Meteorology and Climatology	3
Investigations of the most important agricultural products	1
Discussion on physiological chemical work	2

[3] *Technical Departments.*

Photography, I Part	2
Praktikum for Photography (in groups)	2
Plan-drawing	1
Cartography	1
Graphical Multiplication	2
Construction and management of Electric Railways (II Part)	2
Selected paragraphs in applied Electrotechnics	1
The theory of Fertilisers and their manufacture (gratis)	2

Industrial Hygiene	2
Continuous Current Motors (gratis)	1
Selected chapters from Graphical Statics (gratis)	1
Concrete Structures with Iron Foundations (Monier)	
Selected chapters from the Technique of Electric Current of Low Potential (gratis)	1
Artificial Building Stones	1

B. Philosophical and Political Economy Lectures.

[1] *Literature and Languages.*

Subjects.	Hrs. per week.
German (for non-Germans)	3
Elementary course in Latin	2
Advanced course	2
Lectures and explanations of selections from Orlando Furioso	1
Italy and its Literature in the early part of the XIX Century	2
Russian Language for beginners	3
Russian Language for advanced students	2
Molière, his life and work	1
Contemporary Novelists: A. France—P. Bourget, E. Rod, etc.	1
Contemporaneous Literature	1

Subjects.	Hrs. per week.
Intermediate French course	1
Advanced course: Analytical readings, Conversations	1
Discussions (free course, twice a week)	
The principal works of the German Classics: Lessing, Goethe, Schiller	1
German Literature since 1830: Heine, Lenau, Freiligrath, Schaffel, etc.	1
The German Drama from Grillparzer to Hebbel	1
The life of Shakespeare: With discussion of the Dramas of his age	2
Elementary course in English	2
Readings from English Newspapers and Magazines	1

[2]

[1] A "colloquium" is a discussion on a lecture or a subject, in which both lecturer and students take part.

[2] *Historical and Political Science.*

Subjects.	Hrs. per week.
Raphael of Urbino	1
Art and Artists in Italy since the death of Raphael	1
Political Economy	2
Repetition	1
Financial Science	2
Repetition	1
The third French Republic and the new German Empire (1870-1890)	2
Egypt, Soudan, Abyssinia: the countries, customs, civilisations	1
The explorations of Livingstone and Stanley in Africa	1
Defence and War in the flourishing age of the federation of ancient Switzerland (with demonstrations in the Swiss Museum), II Part	1
Early History of Switzerland (with demonstrations in the Museum), gratis	1
Agrarian Politics, I Part	1
The History of Swiss Civilisation to the time of the Carlovingians	2
Swiss Democracy: The Federation and its Organs	2
The Elements of National Economy ...	3
Repetition	1
Science of Finance	2
Repetition	1
Colloquium on National Economy	1
History of Ancient Art	4
History of the Painting of Germany and Netherlands to the time of Hans Holbein	2
Commercial Law (II Part), with repetition	3
Law relating to technical matter, viz., to Buildings, Railways and Water-rights ...	2
Private Insurance Law	1
Logic	1
Introduction to the reading of philosophical works	1
Theoretical Pædagogy	1
History of democratical ideas in their influence on the State and Society of modern times	2
History of Europe since 1815	2
Historical exercises within the sphere of recent history	1

[3] *Arts.*

Ornamental drawings (from plaster models)	3
Models in clay and plaster	4
Figure drawings (from models)	6
Figure drawings (life-class)	6

11. Zurich School of Military Science.—The last "division" of the Zurich Polytechnicum to which reference is necessary is that for military science. This has two subdivisions—one for general auditors or students, affording an elementary course; and one of a more thorough and professional character for military officers. The courses are as follow hereunder:—

VIII. MILITARY SCIENCE DIVISION.

Section A.

Instruction for students of the Polytechnicum and "Auditors" in general.

Subjects.	Hrs. per week.
Formal Field Fortification	1
Theory of Artillery and Rifle Construction, etc....	1
Theory of Rifle and Artillery Fire for Infantry	1
Rifle and Gun Practice	½ day
Elements of Ballistics	1
History of Ancient War	2

Section B.

Instruction for Officers in particular.

Science of Warfare	1
Practical Ballistics	1
Artillery shooting	2
Science of Weapons and knowledge of War Material	2
Science of Fortification and of the Fortresses of War	3
Discussion and written work on the Science of Weapons and Fortifications	2
Military Topography...	2
Military Geography of Switzerland... ...	2
Infantry Shooting	2
Shooting Practice	½ day
Elements of Ballistics	1
History of Modern Warfare...	2
History of Ancient Warfare	3
Tactics	1
Military Telegraphy and Telephony ...	1
"Repetition," Exercises and Reconnoitring	½ to 1 day

12. *Professors, Assistants, and Privatdozenten, and their Courses.*—The teaching staff in any European Institution is very large.

In order to properly appreciate the character of the teaching, it is necessary to remember that a large staff allows of a degree of specialisation which we cannot claim to have reached even in our highest educational institutions.

The list below will shew the range of teaching of individuals, and the large number of courses in which instruction is actually given.

It is obvious that a high degree of specialism is the secret of the great excellence, since following a thorough general education, a unique opportunity is afforded of becoming very highly proficient.

The

The actual teaching-staff consisists of 74 professors, 26 privatdozenten, 3 assistant professors 1 school-professor. In subordinate teaching, there are also 50 assistants in the various laboratories. There are five custodians of Museum Collections, etc., and six care-takers of the various buildings.

The teaching-staff, and the courses undertaken by each member, are as follow :—

Prof. Dr. F. Affolter, Colonel.

Course	Hours.
1. General Theory of Fortification ...	1
2. Theory of Construction of Weapons	1
3. Science of Warfare	1
4 Practical Ballistics	1
5. Gunnery	2
6. Science of Weapons and Knowledge of War Material ...	2
7. Science of Fortification and Theory of Fortresses	3
8. Discussion and written work on the Science of Weapons and Fortifications ...	2

Privatdozent, C. Baechler.

Course	Hours
9. Dairy Science	2
10. Dairy Science, I (for students desirous of devoting themselves to Dairy Science)	2
11. Dairy Book-keeping	2
12. Inspection of milk...	3

Professor Dr. E. Bamberger.

Course	Hours
13. Inorganic Chemistry	6
14. Repetition ...	1
15. Organic Chemistry, II Part (Benzene derivatives)	2
16. Repetition ...	1
17. Praktikum for Analytical Chemistry (Division IV, 1st Course, and VI B) ...	16
18. Praktikum for Analytical Chemistry (Division IV, 3rd Course, and VI B)	24
19. Praktikum for Analytical Chemistry (advanced students)	daily.

Professor Hon. Dr. J. Barbieri.

Course	Hours
20. Photography, I Part	2
21 Praktikum for Photography, in groups ...	14

Kantonsschulprofessor A. Baumgartner.

22. German Language (for non-Germans) ... 3 hours.

Professor F. Becker, Colonel in the General Staff.

Course	Hours
23. Drawing of Plans ...	2
24. Topographical Drawing	2
25. Chart Drawing	3
26. Chartography	1
27. Military Topography	2
28. Military Geography of Switzerland	2

Privatdozent Dr. Ch. Beyel.

Course	Hours
29. Geometrical introduction to Graphical Statics ...	2
30. Slide-rule, with Exercises ...	1
31. Descriptive Geometry	2

Professor F. Bluntschli.

Course	Hours
32. Architecture (Renaissance) with sketching exercises (3rd Course)	3
33. Exercises in Composition (3 Courses)	8
34. Architecture (Renaissance), 4 Courses ...	2
35. Exercises in Composition (4 Courses) ...	8
36. Exercises in Sketching (making of excursion surveys) ...	2

Professor Hon. Dr. E. Bosshard.

37. Examination and Purification of Waters for technical purposes, viz., for the feeding of boilers 1

Privatdozent Dr. K. Brun.

Course	Hours
38. Raphael of Urbino ...	1
39. Art and Artists in Italy since the death of Raphael ...	1

Privatdozent H. J. Burger.

40. Graphic Multiplication ... 2 hours.

Assistant Dr. R. Burri.

Course	Hours
41. Bacteriology for Farmers, I Part...	1
42. Exercises in the Bacteriological Laboratory (for farmers)	4
43. Exercises in the Bacteriological Laboratory (for dairy technologists) ...	12

Professor Dr. A. P. Charton.

Course	Hours
44. Political Economy ...	2
45. Repetition	1
46. Financial Science ...	2
47. Repetition ...	1

Professor Hon. Dr. E. J. Constam.

Course	Hours
48. Physical Chemistry..	2
49. Physical Chemical Colloquium (gratis) ...	1
50. Employment of Physical Methods in Chemistry (with Professor Dr. Lorenz) ...	½ day
51. "Vollpraktikum" for Physical Chemistry (advanced students) (with Professor Dr. Lorenz) ...	daily.

Professor Dr. O. Decher.

Course	Hours
52. Surveying	5
53. Repetition	1
54. Surveying Exercises, in groups ...	2
55. Geodesy, with repetition	2
56. Praktikum for Geodesy ...	2

Professor M. Decoppet.

Course	Hours
57. Introduction to the Forestry Sciences ...	1
58. Excursions ...	½ day
59. Protection of Forests	3
60. Forestry Policy, Forestry Policy and Statistics	4

Privatdozent Dr. A. Denzler.

Course	Hours
61. Construction and Management of Electric Railways, II Part ...	2
62. Selected chapters on Applied Electro-technics ..	1

Privatdozent

Privatdozent A. Dina.

Privatdozent Dr. J. U. Dürst.

63. The development of the breeding of domostic animals historically treated (gratis) ... 1 hour.

Professor A. Engler.

	Hours.		Hours.
64. Forest Culture, I Part	5	66. Forest Culture, II Part (selected chapter) ...	2
65. Excursions and Exercises	1 day.		

Privatdozent Dr. A. Ernst.

67. Fertilisation, Hybridisation, etc., of Plants... 1 hour.

Professor R. Escher.

68. Mechanical Technology II Part (metal working)	2	71. Engineering	4
69. Repetition (in groups)	1	72. Exercises	4
70. Mechanical Technology IV (spinning and weaving pursuits)	2	73. Milling	2
		74. Technological Praktikum	4

Assistant J. L. Farny.

75. Construction of Dynamos, Part	2	76. Machine Construction	6

Professor Th. Felber.

77. The establishment of Forests	4	79. Excursions and Exercises...	1 day.
78. The use of Forests	3	80. Forestry for Farmers	2

Privatdozent Dr. E. Fiedler, Lieutenant-Colonel.

81. The Theory of Gunnery for Infantry	1	83. Rifle Practice, etc.	½ day.
82. Gunnery, etc., for Infantry	2		

Professor Dr. W. Fiedler.

84. Descriptive Geometry	4	86. Exercises	4
85. Repetition (in groups)	1	87. Geometry of Position	4

Professor Dr. A. Fliegner.

88. Theoretical Engineering, II Part (theory of heat and steam-engines)	4	89. Exercises	3

Professor Dr. J. Franel.

90. Differential Calculus	4	93. Theory of Differential Equations	4
91-92. Repetition, and Exercises in same	3	94. Repetition	1

Professor Dr. J. Früh.

95. The principal atmospheric phænomena (Physical Geography, II Part)	2	96. Geography of Switzerland	2
		97. The regions of North America	1

Professor Dr. C. F. Geiser.

98. Analytical Geometry	4	100. Elements of Ballistics	1
99. Repetition, in groups	1		

Professor E. Gerlich.

101. Road and Railway Construction	5	103. Railway work	1
102. Exercises in designs...	6	104. Repetition	1

Professor Dr. R. Gnehm.

105. Bleaching, Dyeing, and Dyes	4	108. Praktikum for Technical Chemistry (Div. IV A, 3rd and 4th Courses, and VI B) ...	24
106. Repetition...	1	109. Praktikum for Technical Chemistry (advanced students)	daily
107. Praktikum for Technical Chemistry (Div. IV A, 2nd Course)	16		

Professor J. J. Graf.

110. Ornamental Drawing (from plaster models) ...	3	112. Figure Drawing from models	6
111. Models in clay and plaster	4	113. Figure Drawing (life class)	6

Privatdozent Dr. A. Grete.

114. Theory and Manufacture of Manure (gratis) ... 2 hours.

Professor Dr. U. Grubenmann.

115. Mineralogy	4	119. Praktikum for Mineralogical Petrography for advanced students and guidance in independent work	daily
116. Repetition	1	120. Exercises in the Laboratory of Mineralogical and Petrographical Institutes ...	daily
117. Exercises in the determination of minerals ...	3		
118. Praktikum for Mineralogical Petrography for beginners	2		

Professor A. Guilland.

121. The Third French Republic and the New German Empire (1870-1890)	2	123. The voyages of Livingstone and Stanley in Africa	1
122. Egypt, Soudan, Abyssinia : countries, customs, civilsations	1		

Professor G. Gull.

124. Architecture (Mediæval), with sketching exercises (3rd Course)	3	127. Exercises in Composition (3rd and 4th Courses)	8
125. Architecture (Mediæval), with sketching exercises (4th Course)	3	128. Ornament and Decoration (2nd Course) ...	4
126. Exercises in Composition (2 Courses)	6	129. Ornamental and decorative designs, with exercises in composition (3rd and 4th Course)	4

Privatdozent

Privatdozent Dr. J. Häne.

Hours.

130. The Systems of Warfare and Defence in the early times of the old Swiss Confederation (with demonstrations in the Swiss Museum, II Part)... ... 1

Professor Dr. C. Hartwich.

	Hours.
131. Pharmacognosy ...	5
132. Toxicology ...	2
133. Technical Botany I (Fibres and their strength, etc.)	2
134. Praktikum for Pharmaceutical Chemistry ...	12
135. Microscopical examination of pharmaceutical drugs	2
136. Pharmaceutical exercises for advanced students...	daily
137. Chemical inspection of foods and their composition ...	daily
138. Microscopic exercises in the science of foods	in 2 half days
139. Praktikum for Chemistry ...	in 4 half days

Privatdozent Dr. J. Heierli.

140. History of Ancient Switzerland (with demonstrations in the Museum), gratis ... 1 hour.

Professor Dr. A. Heim.

141. General Geology ... 4
142. Repetition ... 1
143. Technical Geology ... 3
144. Repetition ... 1
145. History of the Origin of Man ... 1
146. Seminarial exercises (in conjunction with Professor Dr. Schröter) ... 1

Privatdozent Dr. F. Heinemann (on leave of absence).

Professor Dr. A. Herzog.

147. Mechanics, II Part ... 4
148. Repetition (in groups) ... 1
149. Exercises (in groups) ... 2
150. Selected chapter from Mechanics ... 2

Privatdozent Dr. J. Heuscher.

151. Fishing and Pisciculture ... 2 hours.

Professor K. E. Hilgard.

152. Flow of Waters in Rivers and Canals ... 1
153. Water-works and Canalisation of Municipalities 2
154. Foundations ... 2
155. Exercises in Design (foundations) ...
156. Iron Structures ... 2
157. Exercises in design of same ... 3

Professor Hon. Dr. A. Hirsch.

158. Theory of linear differential equations ... 2 hours.

Privatdozent Dr. O. Hunziker (not on duty.)

Professor Dr. A. Hurwitz.

159. Differential Calculus ... 4
160. Repetition (in groups) ... 1
161. Exercises (in groups) ... 2
162. Differential Equations ... 4
163. Exercises (in groups) ... 1

Professor Dr. C. Keller.

164. General Zoology, with special regard to the most important animals of agriculture and forestry ... 4
165. Repetition ... 1
166. History of the breeds and propagation of domestic animals ... 1
167. Natural History of the human race of the present day ... 1
168. Zoological Praktikum for Agriculture and Forestry ... 2

Privatdozent Dr. J. Keller.

169. Mathematics... ... 4
170. Theory of Central Projection, with application to Practical Perspective ... 2
171. Projective series and pencils with application to the Theory of Construction of Conic Sections ... 2
172. Solution of General Equations of the 3rd and 4th degree, and of any Equations whatsoever, by approximation ... 2

Privatdozent F. Kraft.

173. The general Theory of Elasticity ... 4 hours.

Professor Dr. A. Krämer.

174. The Theory and Practice of General Agriculture, I Part ... 2
175. The Theory and Practice of General Agriculture, II Part ... 3
176. Repetition ... 1
177. Cattle-breeding, II Part ... 2
178. Fundamental Elements of the Practical Arrangement of Agriculture ... 2
179. Agricultural Arithmetic, with Exercises ... 1

Professor M. Lacombe.

180. Descriptive Geometry (Division I) ... 2
181. Exercises ... 4
182. Descriptive Geometry (Division II, III, and VI A.) ... 4
183 and 184. Repetition and Exercises ... 5
185. Geometry of Position ... 2
186. Mathematical Seminarium (in conjunction with Professor Dr. Minkowski) ... 2

Professor Dr. A. Lang.

187. Comparative Anatomy ... 7
188. Repetition ... 1
189. Selected Chapter from the most recent Zoological Researches, III Series ... 1
190. "Vollpraktikum" for Zoological Comparative Anatomy and Introduction to Independent Research ... daily

Professor G. Lasius.

191. Architectural Drawing ... 6
192. Exercises in Sketching ... 2
193. Theory of Architectural Forms, I Part, with Exercises ... 3
194. Theory of Building Construction, I Part ... 2
195. Perspective ... 1
196. Exercises ... 2
197. Interior Work ... 2
198. Theory of Building Construction, II Part ... 2

Privatdozent

Privatdozent Dr. E. Laur.

199. Agricultural Economics, I Part ... ... 1 hour.

Pricasdozent K. Löhle (not on duty).

Professor Dr. R. Lorenz.

	Hours.
200. General Electro-Chemistry	2
201. Chemical Dynamics (Kinetics)	1
202. Praktikum for Electro-Chemistry for beginners	4
204. Applications of Physical Methods in Chemistry (with Professor Hon. Dr. Constam)	½ day.
205. "Vollpraktikum" for Physical Chemistry (advanced students) (with Professor Hon. Dr. Constam)	daily.

Professor Dr. G. Lunge.

206. Inorganic Chemical Technology	4
207. Repetition	1
208. Heating	2
209. Metallurgy	2
210. Repetition	1
211. Praktikum for Technical Chemistry (Division IV A, 2nd Course)	16
212. Praktikum for Technical Chemistry (Division IV A, 3rd and 4th Course, and VI B.) ...	24
213. Praktikum for Technical Chemistry (advanced students)	daily.

Privatdozent Dr. R. Martin

214. Physical Anthropology (the chief diversities of the human race), with demonstrations ...	2
215. Repetition	1
216. Anatomy of Man, with special hours for demonstrations	3
217. Anatomical Exercises and repetition as supplementary to the foregoing lecture	2
218. Anthropological Course for Beginners	2
219. Vollpraktikum for Anthropology (preparatory exercises in principles, and introduction to independent research)	daily.

Privatdozent E. Mertens.

220. Fruit Culture and Science of Fruit. ... .. 1 hour.

Professor E. Meyer.

221. Machine Drawing: Lectures	1
,, ,, Exercises	4
222. Elements of Machine-making	5
223. Repetition	1
234. Exercises in Design	10

Professor Dr. H. Minkowski.

225. Theory of Functions	4
226. Algebraical Numbers	2
227. Seminarial Mathematics (in conjunction with Professor Lacombe)	2

Professor H. Moos.

228. The General Theory of the Production of Animals	2
229. Repetition	1
230. Estimation of Agricultural Production	1
231. Agricultural Book-keeping	2
232. The Breeding of Pigs, Sheep, etc.	2
233. Exercises in Agronomy	2
234. Exercises in the Agricultural Seminary ..	2
235. Agricultural Machines and Tools, I Part ...	2
236. Agricultural Systems of Growths	2
237. Mountain Pasturage	1

Professor Dr. H. Müller-Thurgau.

238. Vine-growing, and the Treatment of the Vine... 1 hour.

Professor Dr. A. Nowaski.

239. Climatology and the Science of Agriculture ...	3
240. Cultivation and Manuring	2
241. Draining and Irrigation	2
242. Exercises in Agronomy	2

Professor Dr. W. Oechsli.

243. History of Swiss Agriculture to the time of the Carlovingians	2
244. The Swiss Democracy: The "Bund" and its Organ	2

Professor Dr. G. Pizzo.

245. Elementary Course in the Italian Language ...	2
246. Advanced Course	2
247. Readings and Explanations on Selections from Orlando Furioso	1
248. Italy and its Literature in the early part of the 19th Century	2

Professor Dr. J. Platter.

249. The Elements of National Economy	3
250. Repetition	1
251. The Science of Finance	2
252. Repetition	1
253. National Economy (Colloquium)	1

Professor Dr. F. Prášil.

254. Hydraulic Motors and Pumps, II Part	4
255. Repetition	1
256. Exercises in Design	12
257. Exercises in Design of Manufacture	4
258. Selected Chapter on Hydraulic Installations of every kind	2
259. Exercises in the Hydraulic Division of the Mechanical Laboratory in groups	½ day.

Professor Dr. J. R. Rahn.

260. History of Ancient Art	4
261. History of the Painting of Germany and the Netherlands to the time of Hans Holbein ...	2

Professor J. Rebstein.

262. Cadastral Survey	3
263. Exercises in same	2
264. Projection in Charts	1
265. Application of geodetical lines to Geodesy ...	2

Professor

Professor B. Recordon.

Course	Hours
266. Building Construction (Division I, 1st Course)	3
267. Exercises in same (Division I, 1st Course)	6
268. Building Construction (Division I and 2nd Course)	3
269. Exercises in same (Division I and 2nd Course)	6
270. Architecture and Building Construction (Division II, 1st Course)	3
271. Exercises in same (Division II, 1st Course)	4

Privatdozent Dr. M. Rikli.

Course	Hours
272. Systematic Botany I (for food analysis, chemists)	1
273. Flora of the Arctic Regions (gratis)	1

Professor Dr. W. Ritter.

Course	Hours
274. Graphic Statics, I Part	2
275. Exercises in Graphic Statics	2
276. Repetition	1
277. Iron Bridges	4
278. Exercises	6
279. Repetition	1

Professor Dr. H. Roelli.

Course	Hours
280. Traffic Laws, II Part, with repetition	3
281. Laws relating to Technics, viz., to buildings, railways; and water-rights	2
282. Private insurances	1

Professor Dr. O. Roth.

Course	Hours
283. Building Hygiene	2
284. Industrial Hygiene	2
285. Exercises in Bacteriology—(for beginners)	5
(for advanced students)	(daily)

For Food Chemists.

Course	Hours
286. Exercises in Bacteriology	In four ½-days.
287. Hygienic Exercises and Excursions	—
288. Hygiene of Foods	1

Professor Dr. F. Rudio.

Course	Hours
289. Higher Mathematics	5
290. Exercises in Groups	2

Privatdozent Dr. R. Saitschick.

Course	Hours
291. Russian Language for Beginners	3
292. Russian Language for Advanced Students	2

Privatdozent Dr. H. C. Schellenberg.

Course	Hours
293. Rearing of Agricultural Plants	1
294. Fermentation and Fermentation Processes	1

Professor Dr. C. Schröter.

Course	Hours
295. Pharmaceutical Botany, with repetition	3
296. Agricultural Botany, with repetition	3
297. Mountain Flora	1
298. Praktikum for Systematic Botany	4 and 8

Professor F. Schule.

Course	Hours
299. Building Statics	3
300. Exercises in same	2
301. Technology of Materials of Construction, II (iron and steel)	2
302. Repetition	1
303. Exercises in Iron Construction	3

Professor Dr. E. Schulze.

Course	Hours
304. Inorganic Chemistry, with repetition	4
305. Agricultural Chemistry, I Part (the theory of plant nourishment)	2
306. Agricultural Chemical Technology (sugar and spirit manufacture, chemistry of the dairy)	2
307. Exercises in the Laboratory for Agricultural Chemistry	8
308. Praktikum for Agricultural Chemistry (advanced students)	(daily)

Privatdozent Dr. A. Schweitzer.

Course	Hours
309. Alternating Current Motors	1
310. Physics (Division II)	4
311. Repetition	1

Professor Alex. Schweizer, Divisional-Colonel.

Course	Hours
312. History of Recent Warfare	2
313. History of Ancient Warfare	2
314. Tactics	1

Professor P. Seippel.

Course	Hours
315. Molière, his life and work	1
316. Contemporary Novelists: A. France, P. Bourget, E. Rod, etc.	1
317. Contemporaneous literature	1
318. Intermediate course of French	1
319. Advanced course. Analytical lectures, conversation	1
320. Discussions. (Free course, twice a month)	–

Professor Dr. A. Stadler.

Course	Hours
321. Logic	1
322. Instruction in the gleanings from philosophic writings	1
323. Theoretical Pædagogy	1

Professor Hon. Dr. M. Standfuss.

Course	Hours
324. Systematizing of Insects (gratis)	1
325. Selected chapter from the Biology of Insects. (gratis)	2

Professor Dr. A. Stern.

Course	Hours
326. History of democratic ideas in their influence on the State and Associations of recent times	2
327. History of Europe since 1815	2
328. Historic Exercises within the sphere of the most recent History	1

Professor Dr. J. Stiefel.

	Hours.
329. The Principal Works of the German Classic writers: Lessing, Goethe, Schiller	1
330. German Literature since 1830: Heine, Lenau, Freiligrath, Scheffel, etc.	1
331. The German Drama from Grillparzer to Hebbel	1

Professor Dr. A. Stodola.

332. The construction of steam-engines, I Part (distributing-regulators and regulators)... ...	4
333. Exercises in same	2
334. Gas motors (introduction)...	1
335. Boilers and selected chapter on the construction of steam-engines	2
336. Contruction of machines and designs of complete installations of steam-power... ...	6
337. Exercises in the thermal division of the mechanical laboratory in groups	(½-day)

Privatdozent G. Thurnherr.

338. Selected chapter from Graphic Statics (gratis) ..	2
339. Stress structures with iron foundations ...	2

Professor Hon. Dr. A. Tobler.

340. Electrical Signal Apparatus for railways ...	2
341. Selected chapter from the technique of currents of low potential...	1
342. Military telegraphy and telephony	1

Professor F. P. Treadwell.

343. Analytical Chemistry, I Part	2
344. Analysis of gas with exercises (in groups) ...	1
345. Analysis of foods with exercises (in groups) ...	2
346. Chemistry (Divisions II and III)	2
347. Repetition	2
348. Praktikum for Analytical Chemistry (Division IV, 1st course, and VI B.)	16
349. Praktikum for Analytical Chemistry (Division IV., 3rd course, and VI. B.)	24
350. Praktikum for Analytical Chemistry for advanced students	(daily)

Professor Dr. Th. Vetter.

351. The life of Shakespeare, with discussions of the Dramas of the men of his age...	2
352. Elementary course in English	2
353. Readings from English newspapers and journals	1

Professor A. Weber.

354. Mechanics and Engineering	4
355. Repetition	1
356. Engineering	2
357. Repetition	1
358. Exercises in design	4
359. Industrial arrangements and buildings ...	2
360. Exercises in design	—

Professor Dr. H. F. Weber.

361. Physics	4
362. Repetition	1
363. Principles, apparatus and methods of measuring for Electro-technics	4
364. The system of alternating currents and motors	2
365. Electro-mechanics	2
366. Laboratory for Electro-technics	8 or 16
367. Scientific work in the physical laboratories	8, 12, 24
368. Experimental researches in alternating currents and motors	4

Professor Hon. Dr. A. Wellenmann.

369. Meteorology and Climatology ... ... 3 hours.

Professor Dr. P. Weiss.

370. Physics	4
371. Repetition	1
372. Theoretical and experimental optics	2
373. Praktikum for Physics for beginners	4 and 8
374. Scientific works in the Physics laboratory ...	4, 8, 24

Assistant Dr. E. Winterstein.

375. Chemistry of milk and milk products	2
376. Examination of the most important agricultural products	1
377. Discussion on the works of Physiological Chemistry	2

Professor Dr. A. Wolfer.

378. The elements of Astronomy	3
379. Exercises therein	2
380. Theory of Eclipses and allied phænomena ...	2

Professor Dr. W. Wyssling.

381. Central electrical stations, II Part	2
382. Exercises and constructions	3
383. Transmission of electrical power and lighting	3
384. Repetition...	1

Privatdozent B. Zschokke.

385. Artificial building stones ... ... 1 hour.

Dr. E. Zschokke, Professor in the University.

386. Regimen of domestic animals ... ... 2 hours.

Professor C. Zwicky.

387. The drawing of plans	4
388. Laws relating to technics	1
389. Surveying	3
390. Exercises therein	2
391. Road and waterworks with repetition ...	4
392. Exercises in design	4
393. The technics of cultivation	3
394. Exercises in design	6

13. *Collections, Equipment, and Institutes, Zurich Polytechnicum.*—The collections and equipment of the Zurich Polytechnicum are very complete. They are briefly as follows:—

Library.

Collection of building materials; collection of building models; architectural models; models for figure and agricultural drawing; collection of copper-plate engravings or prints; archeological collection.

Geodetical collection; engineering science models.

Machine models; models for engineering drawing; mechanical technological collection; collection of tools.

Collection for chemical technology; pharmaceutical collection.

Collection for forestry economy; agricultural collection.

Models for mathematics and descriptive geometry: astronomical collection; collection for physics; mineralogical collection; collection for geological palæontology; botany collection.

Zoological collection; entomological collection; workshops for modelling in clay and plaster; workshops for work in metal.

Observatory.

Physics Laboratories: (a) For physical exercises; (b) for electro-technical work; (c) for scientific studies.

Mechanical laboratory.

Laboratory for analytical chemistry; laboratory for technical chemistry; laboratory for electro-chemistry; laboratory for pharmaceutical chemistry; laboratory for agricultural chemistry; bacteriological laboratory; photographical laboratory.

Botanical gardens; institute for the physiology of plants; agricultural experimental field.

With the School are connected the Institution for the testing of materials and the Central Institution for experiments in forestry.

During the Commissioners' visit to the Polytechnicum the following features were specially noticed, viz.: In the laboratory for testing the general properties of the materials of construction; apparatus for testing the hardness of materials by the rate of wear through attrition; refrigerating machinery for testing the action of freezing on building materials; the usual apparatus for testing the elastic modulus, and tensile, compressional, and torsional strength, etc.; a laboratory for the analysis of the metals tested, etc.

The mechanical laboratory was magnificently equipped on a fine scale. The following were noticed:—A 120-h.p. steam engine (150 revols., 12 atmosp.); a 12-h.p. Laval steam turbine, running 24,000 revolutions, geared down to one-tenth; a triple-phase generator, 100 h.p., 250 revs.; a generator for developing triple or single phase current; petroleum and gas engines, 4 h.p., 200 revs, and 3 h.p., 300 revs. respectively; a 9-h.p. "Escher" engine, 250 revs., new construction; a small three-phase motor, 720 revs.; a double centrifugal pump, 800 revs., delivering 70 litres per second through 45 metres vertically; a large pump, delivering 800 litres per second through a height of 5 metres; a 32-h.p. Pelton wheel; a 22-h.p. turbine Girard. For electric current a storage battery of 144 large cells is used. Many other features were noted which need not be referred to in detail.

14. *General Remarks.*—The number of students at the Polytechnicum on the occasion of the Commissioners' visit was 1,636, of which 1,065 were regular and 571 irregular. Two-thirds (about) were Swiss and one-third foreigners (*e.g.*, of the 1,065 regular students, 707 Swiss, 358 foreigners), and the following countries are represented among the students, viz.:—Austro-Hungary 94, Germany 37, Russia 32, Roumania 31, Italy 30, Holland 27, Scandinavia 22, America 18, Great Britain 14, France 12, Denmark 11, Luxemburg 8, Greece 6, India 6, Turkey 4, Africa 2, Belgium 2, Spain 2.

It may be mentioned that 175 students of the University of Zurich were also in attendance at the courses.

Extensive enlargements of the buildings have been necessary to equip the mechanical laboratory satisfactorily, and the whole school was undoubtedly one of the most finely-equipped institutions seen by the Commissioners.

CHAPTER XXXIV.

Higher Technical Education in other European Countries.

[G. H. KNIBBS.]

1. *Introduction.*—Limitations of various kinds render it impossible to attempt anything like a complete account of the various forms of higher technical and professional education in the various countries of Europe. Generally speaking, it may be said that the highest form of technical education is to be found in the science and professional courses of the Universities. The instruction, however, is but rarely given, with first regard to its applications; hence science schools are not technical schools in the strict sense.

This chapter proposes to briefly indicate the scheme of higher instruction of a technological character in the various countries in Europe, not already dealt with.

2. *Austrian Technical High Schools.*—In Chapter XII of this Report, an account has been given of the lower forms of technical instruction. The various types of high school, *i.e.*, schools of university grade, that exist in Austria are:—

(1) Universities (*Universitäten*).
(2) Technical High Schools (*Technische Hochschulen*).
(3) High Schools of Agriculture (*Hochschulen für Bodencultur*).
(4) Mining Academies (*Berg-Akademien*).
(5) Art Schools (*Kunstschulen*).
(6) Theological Schools (*Theologische Lehranstalten*).

The Universities are those of Vienna, Graz, Innsbruck, Prague (Bohemian), Prague (German), Lemberg, Cracow, Czernowitz.

The Technical High Schools are those of (1) Vienna; (2) Graz; (3) Prague (Bohemian); (4) Prague (German); (5) Brünn; (6) Lemberg. The organisation is similar in each, excepting that Brünn is somewhat less complete. The instruction falls under (say) five headings, viz.:—

(i) Civil Engineering; (ii) Architectural Engineering; (iii) Mechanical Engineering; (iv) Chemical Technology; (v) Special Subjects.

In the High School of Agriculture at Vienna, the divisions are:—

(i) Agriculture; (ii) Forestry; (iii) Culture Technology.

The Mining Academies are the following, viz.:—

The Imperial Royal Mining Academy of Leoben in Steiermark (*kaiserl. königl. Berg-Akademie*), and that at Příbram in Bohemia. The latter has three departments, viz.:—

(i) General Division; (ii) Professional School of Mining; (iii) Professional School of Metallurgy.

The Art Schools are the Imperial Royal Academy of Vienna, the Art Academy of Prague, and the Art School of Cracow. The school in Vienna is subdivided as follows:—

(i) General school of painting; (ii) of sculpture; (iii) special school for historical painting; (iv) for landscape; (v) for copper-engraving; (vi) for engraving and medal-engraving; (vii) for architecture; (viii) for higher sculpture.

The general organisation of the Austrian Technical High School is similar to that of Germany, and the degree of Doctor of Engineering is conferred.

The difference even between Austrian and Bohemian schools is not marked. For example, the departments or sections of the Technical University of Prague are[1]:—

(*a*) Department of Civil Engineering (*odbor stavebního inženýrství*).
(*b*) „ „ Architecture (*odbor stavitelství pozemního.*)
(*c*) „ „ Mechanical Engineering (*odbor strojního inženýrství*).
(*d*) „ „ Technical Chemistry (*odbor technické chemie*).

3. *Laboratory Equipments, Austrian Technical High Schools.*—The equipments in different schools are by no means identical. While they are much the same for the more elementary parts of the demonstrations and laboratory practice, for the advanced work they shewed marked differences. For example, in the Technical University of Prague—which throughout is magnificently equipped—there was a complete plant for sugar manufacture in small quantities, and every branch and phase of the sugar industry is represented in its museum. The sugar industry is locally very important. Incidentally it may be mentioned that the designs of sugar factories made by the students were excellent.

Professor

[1] See Programm Čís. Král. České Vysoké Školy Technické v Praze. 1901-2.

Professor Tetmaier's laboratory for testing material, and for instruction and demonstration in engineering, at the very fine Technical High School of Vienna, was specially good.

It was noticed that the equipments of all the laboratories had been recently increased and additions were in progress. In the chemical laboratories Nemetz balances had been introduced, in which the weights were mechanically added to the load in the pan.

4. *Finland Polytechnicum.*—The Polytechnic Institute of Finland (*Suomen Polyteknillinen Opisto*), situated in Helsingfors, is also a well-equipped technical University, organised very similarly to the German technical high schools. It has a branch for (i) Architecture (*Arkkitehtuuriosasto*); (ii) Engineering (*Insinööriosasto*); (iii) Machine construction, *i.e.*, Mechanical Engineering (*Konerakennusosasto*); (iv) Chemical Technology (*Kemiallis-teknologinen osasto*); (v) Land Surveying (*Maanmittausos*); and besides these defined courses there are optional subjects.

The working hours range from 23 to 46 hours per week, the average for obligatory subjects being 34.

The detailed subjects are:—

English.	*Finnish.*
Mathematics.	Matematikka.
Physics.	Fysikka.
Physical laboratory work.	Fysikaaliset laboratsioonit.
Mechanical theory of heat.	Mekaaninen lämpöteoria.
Electro-technics.	Elektroteknikka.
Electro-technical laboratory work.	Elektroteknilliset laboratsioonit.
Practice in electro-technical construction.	Elektrotekn.konstruktsioonibarjoit.
Technical mechanics.	Teknillinen mekanikka.
Analytic mechanics.	Analyyttinen mekanikka.
Analytic geometry.	Analyyttinen geometria.
Descriptive geometry.	Deskriptiivinen geometria.
Projective geometry.	Projektiivinen geometria.
Inorganic chemistry.	Epäorgaaninen kemia.
Organic chemistry.	Orgaaninen kemia.
Analytic chemistry.	Analyyttinen kemia.
Theoretical chemistry.	Teoreettinen kemia.
Chemical laboratory practice.	Kemialliset laboratsioonit.
Mineralogy and geognosy.	Mineralogia ja geognosia.
Metallurgy.	Metallurgia.
Chemical technology.	Kemiallinen teknologia.
Mechanical technology.	Mekaninen teknologia.
General theory of mechanisms.	Yleinen koneoppi.
Machine construction.	Konerakennus.
Testing materials.	Aineiden koetus.
Machine design.	Konepiirustus.
Theory of machines.	Teoreettinen koneoppi.
Kinematics.	Kinematikka.
Graphical statics.	Graafinen statikka.
Elements of construction.	Pohjarakennus.

English.	*Finnish.*
Hydraulic construction.	Vesirakennus.
Bridge construction.	Sillanrakennus.
Statics of building construction.	Rakennuskonstruktsioonien statikka.
Railway construction.	Rautatienrakennus.
Earthworks and roads, etc.	Maa-ja tierakennus.
Encyclopedic knowledge of engineering science.	Insinööritieteiden ensyklopedia.
Practical geometry.	Käytännöllinen geometria.
Geodesy.	Geodesia.
Theory of building construction.	Rakennuskonstruktsioonioppi.
Architecture.	Arkkitehtuuri.
History of Art.	Taidehistoria.
Freehand and linear drawing.	Käsivarais-ja viivasinpiicustus.
Watercolour painting.	Akvarellimaalaus.
Figure drawing and modelling.	Kuviopiirustus ja modelleeraus.
Surveying.	Maanmittaustehtäviä.
Land survey regulations (?)	Maanmittausasetukset.
Agronomy and forestry.	Maanviljelysoppi ja metsätalous.
National economy and industrial legislation.	Kansantalous ja teollisuuslains äädäntö.
Swedish language.	Ruotsin kieli.
Finnish ,,	Suomen ,,
Russian ,,	Wenäjän ,,
German ,,	Saksan ,,
English ,,	Englannin ,,
French ,,	Ranskan ,,
Book-keeping.	Kirjanpito.

The mathematics include—

Trigonometry.	Trigonometria.
Algebra.	Algebra.
Determinants.	Determinanttilasku.
Differential calculus.	Differentsiaalilasku.
Integral calculus.	Integraalilasku.
Differential equations.	Differentsiaaliekvatsioonit.

All the departments are four years, with the exception of surveying, which is only two years

The personnel of the Institute consists of the Inspector (*Inspehtori*), whose title indicates his function; the Director (*Tirehtori*), in charge of the whole establishment, who is also a teaching professor; the pro-Director (*Varatirehtori*), also a member of the teaching staff; the Senior Teachers (*Vanhempia Opettajia*), some of whom are titular professors, town councillors, professional engineers, architects, etc.; the Junior Teachers (*Nuorempia Opettajia*); the Assistant Teachers (*Apuopettajia*); the Extra or Special Teachers (*Ylimääräisiä Opettajia*); the officers of the secretarial bureau (*Kanslia*).

The Institute possesses a fairly extensive library (*Kirjasto*), and has testing establishments (*Ainekoetuslaitos*) for cement, and for stone and metals.

The individual courses are very completely organised, and the publications of the original work of the Institute disclose the high character of its effort. The following are treatises produced by the teaching staff of the Institute:—

(*a*) Ueber eine Verallgemeinerung der Riemannschen Function $\zeta(s)$, von Hj. Mellin. (On a generalisation of Riemann's function $\zeta(s)$.)

(*b*) Zur kinetischen Theorie der festen Körper, von K. F. Slotte. (On the kinetic theory of solid bodies.)

(*c*) Kondensations försök med amylen, von Ossian Aschan. (Condensation experiments with amylene.)

(*d*) Ueber die Constitution einiger gesättigten Dicarbonsäuren, von Gust. Komppa. (On the constitution of some saturated dicarbon acids.)

(*e*) Grunderna af potentialteorin med användning på elektrostatiken och magnetismen, von Hj. Tallqvist. (Elements of the theory of potential, with applications to electrostatics and magnetism.)

This last is itself 250 pp. quarto.

Owing

Owing to the great limitation of time, the Commissioner was unable to do more than quickly pass through the laboratories of the Institute. What little was seen was sufficient to render it obvious that the work was excellent, and that the student entered on his course well prepared.

5. *Higher Technical Education in Holland.*—The lower forms of technical education in Holland have been referred to in Chapter XIII hereinbefore. Higher technical and professional education is not definitely organised in the Universities, but the Polytechnic School of Delft (*Polytechnische School te Delft*) may be taken as the Dutch idea of technical education. This school has branches of instruction, *i.e.*, organised courses, for the

I. Civil Engineer (*Civiel-ingenieur*).
II. Architect (*Architect of bouwkundig ingenieur*).
III. Naval Architect (*Scheepsbouwkundig ingenieur*).
IV. Mechanical Engineer (*Werktuigkundig ingenieur*).
V. Mining Engineer (*Mijnen-ingenieur*).

The courses include the following, viz. :—

(1) Descriptive geometry. (2) Analytical and spherical geometry. (3) Analysis, differential and integral calculus, and integration of differential equations. (4) Extension of the above. (5) General course in mechanics. (6) Kinematics. (7) Theory of building construction. (8) Graphical statics. (9) Rudiments of theoretical and applied mechanics. (10) Rudiments of applied mechanics. (11) Land surveying, levelling, and geodesy, general course. (12) Special instruction, *e.g.*, theory of errors, of least squares. (13) Practical work. (14) Geodesy. (15) Plans, etc. (16) General course in applied science, viz., heat, light, magnetism, electro-statics, electro-dynamics. (17) Special courses, viz., physical measurements, interference, refraction, etc. ; microscopy and spectroscopy. (18) Electro-technics, viz., magnetic and electric measurements, theory of continuous current dynamo, dynamo construction, accumulators, conduction and distribution of electric energy, continuous current electromotors, theory of alternating current, generators, converters, transformers, conduction and distribution of alternating current, alternating current electromotors. (19) Practical work. (20) Measurement, weighing, etc. (21) Theoretical chemistry (electro-chemistry). (22) Inorganic chemistry (metals and non-metals). (23) Organic chemistry, aromatic compounds. (24) Special courses (colours, dyes, etc.). (25) Analytic chemistry. (26) Chemistry for engineers. (27) Laboratory practice. (28) Chemical technology (general course, inorganic substances). (29) Special courses (combustibles, water, etc.). (30) Micro-chemistry, preparatory course. (31) Special courses (microscopy of metals and alloys). (32) Practical exercises. (33) Special course in micro-chemistry. (34) Bacteriology (general). (35) Special and technical bacteriology. (36) Practical exercises. (37) Microscopic anatomy. (38) Hydraulics (sluices, canals, harbours, flow in pipes, channels, etc.). (39) Practical work. (40) Bridges. (41) Roads and railways. (42) Special practice. (43) Building material. (44) Sewers, water, and gas supply. (45) Building in different materials. (46) Building construction. (47) Projections, etc. (48) Drawing various types of houses. (49) Design of buildings. (50) Specifications and estimates. (51) Architectonic theory. (52) History of architecture. (53) Decorative art. (54) Drawing, painting, etc., and history of art. (55) Modelling. (56) Naval architecture. (57) Mechanical technology of metals. (58) Technology of various manufactories. (59) Practical work with various kinds of paper. (60) Practical work in wood and metal. (61) Workshop machinery. (62) Machinery in different factories. (63) Locomotives, etc. (64) Mechanical engineering. (65) Physical mineralogy. (66) Chemical mineralogy. (67) Geology. (68) Mining. (69) Special practical work. (70) Metallurgy, general. (71) Special practice, docimacy, etc. (72) Political economy, its history, modern socialism. (73) Administrative laws, general course. (74) Special courses concerning railways, factories, mining, etc.

The laboratory equipment is well developed, and although somewhat in disorder owing to alterations in the building at the time of the Commissioner's visit, the excellence was apparent. Attendance is not compulsory, that is, the freedom of the student is assured as at a Continental University, and the diploma is conferred on the examinations being passed in any of the branches just mentioned.

6. *Higher Technical Education in Italy.*—A fairly comprehensive account of Industrial and Technical Education in Italy is given in Chapter XV hereinbefore—Sections 2–13. The highest type of instruction is, of course, to be found in the Universities, the higher technical institutes, and the practical schools for engineers, etc.

The Royal Schools of Application for Engineers (*le regie scuole d'applicazione per gli ingegneri*)[1] have for their object the scientific and technical education necessary for the civil engineer and the architect,[2] the diplomas conferred giving the rights to direct civil, rural, hydraulic, and mechanical constructions, and civil and rural buildings, etc., respectively.

The courses are three years, and are as follows :—

First Year.—Rational mechanics, with exercises ; theoretical geodesy, with exercises ; graphical statics, with drawing ; applications of descriptive geometry, with drawing ; chemistry, with manipulation.

The other two years differ according as engineering or architecture is taken.

Second and Third Years (Engineering).—Mineralogy and geology as applied to materials of construction ; practical geometry ; mechanics applied to machinery ; mechanics applied to construction ; practical hydraulics ; hydraulic machinery ; agricultural machinery ; architecture ; civil and rural construction ; foundations ; bridge construction ; roads and railways ; hydraulic and maritime construction ; agricultural hydraulics and ameliorations ; rural economy and estimates ; technological physics ; law.

Second

[1] For the constitution of these, see *Codice pubblica istruzione*, I, pp. 341–2.
Regio decreto, 8 ottobre, 1876, n. 3434. *Ibid.*, p. 445.

Second and Third Years (Architecture).—Mineralogy and geology applied to materials of construction; practical geometry; mechanics applied to construction; architecture; civil and rural constructions; economy and rural estimates; technological physics; law. The architectural students are required, also, to attend the classes for architecture in the local academy or institutes of fine arts.

Graphical work, practical exercises, excursions, experimental and repetition work form a feature of the courses.

The *Scuola di applicazione degl' ingegneri in Torino* is governed by a different decree,[1] and is associated with the Royal Industrial Museum,[2] a brief reference to which may now be made.

7. *Royal Industrial Museum of Turin.*—The "*Regio museo industriale italiano in Torino*" is probably one of the best equipped in Italy. It was created in 1862, with the object of promoting the interests of industry and commerce and perfecting industrial education.

The courses in this institution are—

I. Higher course. II. Course for so-called industrial engineers (three years). III. Special courses. IV. Normal courses for teachers of technical and industrial schools. V. Individual courses.

The institution possesses very well-equipped special laboratories for electro-technics, industrial physics, and chemistry, mechanics, textile technology, the paper industry. In addition, its museum exhibits a large collection of raw and manufactured products, both local and foreign, a collection of machinery and special parts of machinery, and a fine technical library.

At the time of the Commissioner's visit it was noticed that the apparatus for the teaching of electro-technics had been added to in a very liberal way. The lecture-room for electro-technics was almost ideally equipped.

Under the heading I (higher courses) the divisions are the following:—

(1) Electro-technical science and its subdivisions.
(2) Electro-chemistry.
(3) Tinctorial chemistry.
(4) Paper manufacture.

8. *Higher Course in Electro-technics.*—The course in *electro-technics* lasts one year, and embraces general electro-technics, electric measurements, electro-mechanical construction, telegraphy and telephony, practical work.

Admission to this course is permitted to the following, viz.:—

Engineers possessing the diploma of the school of application, military engineers, artillery officers, naval officers and engineers, doctors of physical and mathematical science.

For the course in telegraphy and telephony, the technical employés of the Telegraphic Department and of the Telephone Society are admitted.

Each student has a bench to himself for the study of electrical phænomena, the undertaking of electrical measurements, etc. The laboratory has a fine set of Kelvin balances, transformers, generators, alternators; 1, 2, and 3 phase transformer, 3-phase motor, etc.; Siemen's and Halske's apparatus for illustrating Marconi telegraphy.

9. *Higher Courses in Electro-chemistry.*—The higher course in electro-chemistry consists of lectures and practical exercises, and is organised in a manner analogous to the previous course. At the time of the Commissioner's visit there were about 350 industrial engineers present.

In the drawing-book the student makes complete drawings of the whole apparatus for any development of chemical industry studied by him.

The equipment is, if anything, more complete than for the course in electro-technics.

10. *Higher Courses in Tinctorial Chemistry and Paper Manufacture.*—For the course in the chemistry of dyes and dying, the laboratory is very extensive. Students from the *liceo* attend this laboratory also. The details of the course call for no special comment.

The course in paper-making is illustrated by the use of a small paper-making plant.

"Industrial engineers," doctors in chemistry, and the licentiates of the courses in chemical industry of the Museum are admitted to these courses, which last from four months upwards.

11. *Courses qualifying as Industrial Engineers.*—These courses are of three years' duration. The subjects of instruction are:—Chemistry of minerals, analytic and industrial chemistry, with laboratory exercises, mechanical drawing, kinematics, graphical statics, industrial physics, mechanical construction, industrial economy and legislation, general electro-chemistry, mechanical and textile technology, metallurgy and mining, steam-engines.

Until the mechanical laboratory was developed, students undertook their manual work in the industrial workshops of the city.

12. *Special Courses, Turin.*—These are various. There are higher courses in industrial ornamentation lasting three years; descriptive geometry, history of applied art, exercises in drawing and modelling. Admission to these involves a previous two years' attendance at one of the schools of fine art, or the completion of the course in the lower schools of applied art.

There are also theoretical and practical courses for customs officers, the duration being at least six months. The subjects of instruction are chemistry and merchandise, thread, fabrics, mechanics, metallury.

13.

---

[1] Regio decreto, 11 ottobre, 1863, n. 1516.
[2] Regio decreto, 3 luglio, 1879, n. 4993. See also reg. decr., 29 giugno, 1879, n. 2282; reg. decr., 22 aprile, 1897, n. 150

13. *Courses for Teachers in Industrial Schools.*—There are three sections, viz., for chemistry, mechanics, electricity, the course in each lasting three years. The detailed teaching embraces the following, viz.:—

Chemical Industry.—General inorganic, organic, and analytical chemistry, with laboratory practice; industrial chemistry, also, with laboratory practice; general and applied physics; elementary and applied mechanics; hydraulics; metallurgy.

Mechanical Industry.—Applied kinematics; elementary and applied mechanics; hydraulics; general and applied physics; construction of machinery; mechanical and textile technology; metallurgy, laboratory and workshop practice and drawing.

Electrical Industry.—Principles of electro-technic applications to the construction of machinery; general and applied physics; mechanics and mechanical technology; hydraulics, drawing, laboratory work in electro-technics and workshop practice.

Students are admitted who possess the *licenza* of the lyceum (*liceo*) or of the physico-mathematical or industrial section of a technical institute, or of a nautical institute.

The license is awarded to those who pass the final examination. In 1901 there were 88 students in electro-technics; 20 in electro-chemistry; 292 in industrial engineering.

14. *Royal Higher Technical Institute and Engineering Schools annexed to Universities.*—There are higher technical institutes in Italy, in which the higher forms of technical education are afforded. The one in Milan (*R. Istituto Tecnico Superiore di Milano*) may be taken as an illustration.

It consists of the following:—

(1) A two-year preparatory school for the purpose of completing the scientific, literary, and artistic education of those who have passed through the physico-mathematical section of the "technical institutes."
(2) A civil engineering section.
(3) One for industrial engineers.
(4) One for architects; and
(5) One for teachers in technical institutes.

The *Schools of Application for Engineers* (Scuole d'applicazione per gl'ingegneri) may be annexed to Universities, that is to the faculty of physical, natural, and mathematical science.[1]

The courses of instruction are as follows, viz.:—

Civil Engineers.—Rational and applied mechanics, graphical statics, fluvial hydraulics, agricultural hydraulics, water supply, industrial mechanics, applications of descriptive geometry, geodesy, topography, technics of architecture with civil constructions, hydraulic constructions, bridges and roads, agronomy and rural economy, technical physics, applied mineralogy, applied chemistry, the various branches of practical engineering, drawing, etc., etc.

Architectural Engineers.—Rational and applied mechanics, graphical statics, applications of descriptive geometry, topography, architectural technics in civil constructions, physical technology, applied mineralogy, various branches of practical architecture and drawing, etc., etc.

The *courses for teachers* vary with each subject as follows, viz:—

Teachers of Mathematics in the Technical Institutes.—I, Rational mechanics; II, applied mechanics; III, graphical statics; IV, higher geometry; V, higher analysis; VI, geodesy; VII, applications of descriptive geometry; VIII, mathematical physics; IX, a foreign language, German or English; X, conferences on the teaching of mathematics in secondary schools.

Teachers of Physics.—I, Rational mechanics; II, applied mechanics; III, geodesy; IV, mathematical physics; V, experimental physics; VI, technological physics; VII, mineralogy; VIII, practical exercises in experimental physics, two years; IX, practical exercises in chemistry, one semester; X, a foreign language, German or English; XI, conference on teaching of physics in secondary schools.

Teachers of Chemistry.—I, Rational mechanics; II, chemistry; III, practical exercises in chemistry, two years; IV, mineralogy; V, botany; VI, anatomy and comparative physiology; VII, practical exercises in experimental physics, one year; VIII, practical exercises in mineralogy, one semester; IX, a foreign language, German or English; X, conferences on the teaching of chemistry in the secondary schools.

Teachers of Natural History.—I, Mineralogy; II, geology; III, zoology and zootomy; IV, general and special botany; V, anatomy and comparative physiology; VI, practical exercises in mineralogy and geology, two years; VII, in botany and zoology, two years; VIII, practical exercises in physics and chemistry, one semester; IX, a foreign language, German or English; X, conferences on the teaching of natural history in secondary schools.

15. *General Remarks on Technical Education in Italy.*—Although the equipments for technical instruction in Milan, Venice, Bologna, Florence, Genoa, and Rome, are not yet comparable in completeness to those of the Technical High Schools of Germany, they nevertheless disclose a serious effort to keep pace with the great extensions of modern science and its applications in technology. As already remarked, the equipment in Turin seems to be of the first rank, both in extent and quality. In the higher technical schools the work is thoroughly co-ordinated, and thorough preparation is insisted on.

16.

---

[1] For an example of the organisation see the Regolamento organico della scuola d'applicazione per gl' ingegneri, annessa alla facoltà di scienze fisiche naturali e matematiche della regia Università di Roma. Cod. pubb. istruz. Vol. I, pp. 477-480.

16. *Higher Technical Education in Russia.*—Russian technical education may be divided into higher, secondary and primary, the general idea of the scheme having been already outlined, viz., in Chapter XVII hereinbefore, see Section 2.

There are a number of higher schools in Russia, among which may be mentioned the following, viz.:—

(1) Higher Technological Institute of Nicholas I, St. Petersburg.
(2) Polytechnic Institute of St. Petersburg.
(3) Electrotechnical Institute of Alexander III, St. Petersburg.
(4) Institute of Mines of Catherine II, St. Petersburg.
(5) Institute of Road Engineers, etc., of Alexander I, St. Petersburg.
(6) Institute of Civil Engineers of Nicholas I, St. Petersburg.
(7) Imperial Technical School of Moscow.
(8) Polytechnic Institute of Riga.
(9) Technological Institute of Alexander III at Kharkoff.
(10) Imperial School of Engineers, Moscow.
(11) Polytechnic Institute of Alexander II, at Kieff.
(12) Polytechnic Institute of Nicholas II, at Warsaw.
(13) Higher School of Mines of Ekaterinoslav.
(14) Higher Technological Institute of Tomsk.

This list is sufficient to give a definite idea of the lavish provision made for technical education in Russia. A slight account of some of them will be given.

17. *Higher Technological Institute of Nicholas I.*—This establishment was opened in 1831, and admitted pupils for a period of six years, at the ages of 13–15. It had only two sections, mechanics and chemistry. In 1887 it was reorganised, and the buildings and laboratories were greatly enlarged and improved. In 1898 it was again extended and its equipment added to.

The object of the instruction is to educate mechanicians and chemists. For entrance it is necessary to have obtained the diploma of a classical or "real" gymnasium, and to pass a severe examination, since the number of applicants always exceeds the available places. The fee is 50 roubles (roughly, £5) per annum. The course is initially common; during the second year the mechanicians and chemists separate for part of the work; the fifth year is wholly practical work in the laboratories.

18. *Courses in Russian Technological Institute.*—The courses consist of common parts, and parts taken by mechanicians or by chemists. They are as follow:—

PROGRAMME OF THE TECHNOLOGICAL INSTITUTE OF NICHOLAS I.

First Year.

Subjects.	Hrs. per week.
Religion	2
Analytic Geometry, Advanced Algebra, Differential Calculus, Elementary Integral Calculus	5
Descriptive Geometry	2
Physics (apparatus, measurement, molecular physics)	3
Mineralogical Chemistry	5
Theoretical Mechanics	3
Geodesy	2
Total	22

Second Year.

Subjects.	Hrs. per week.
General Mechanics	2
Physics (heat, electricity)	3
General Chemistry (metals)	3
Resistance of Materials, Organs of Machines	4
Applied Mechanics	3
Architecture	2
Construction	3
Integral Calculus[1]	2
Analytical Mechanics[2]	2
Mineralogy and Geodesy[3]	2
Total	24 or 22

Besides the above, technical and architectural drawing is executed by all pupils.

The work of the third year is as follows:—

Third Year—Common Part.

Subjects.	Hrs. per week.
Mechanical Theory of Heat	4
Boilers	2
Technology of Metals and Alloys	2
Electrical Measurements	3
Heating and Ventilation	2
Total	13

Mechanicians.

[1] For mechanicians only.
For mechanicians only, and during one semester only.
[3] For chemists only.

Mechanicians.

Subjects.	Hrs. per week.
Applied Thermodynamics (1 semester) ...	4
Lifting Machinery (1 semester)	3
Graphical Statics	2
Hydraulics and Hydraulic Motors	2
Construction of Steam Engines	2
Metallurgy of Iron (1 semester)	2
Theory of Probability (optional)	2
Obligatory total ...	13
Grand total	26

Chemists.

Subjects.	Hrs. per week.
Organic Chemistry...	3
Analytical Chemistry	2
Technology of Mineral Substances ...	4
Anatomy and Physiology of Plants (1 semester)	3
Total	12
Grand total	25

Besides the above, there is drawing, viz., architectural, for both sections, mechanical drawing, and work for the mechanicians, and practical microscopy and chemistry for the chemists.

The fourth year work has also a common part, as is shewn hereunder:—

Fourth Year.

Mechanicians.

Subjects.	Hrs. per week.
Electrotechnical Theory (optional)... ...	2
Construction and Calc. Dynamos (optional)	3
Technology of Textiles	4
Hydrotechnical Construction	2
Theory of Elasticity of Solids (optional) ...	2
Statics of Construction	3
Technology of Metals	4
Construction of Metallurgical Works ...	2
Woodwork	2
Theory of Locomotive Construction ...	3
Obligatory total ...	20

Chemists.

Subjects.	Hrs. per week.
Same as for Mechanicians... ...	2, 3, 4, 2
Theoretical Chemistry	4
Technological Chemistry (naphtha, fats, oils, leather, paper, gas, distillation of wood)	5
Technology of Colouring Matters ...	6
Obligatory total ...	21

All the pupils work in the physical cabinet or laboratory. The mechanicians must design a boiler, steam-engine, and hydraulic motor. The chemists design a boiler, a factory of chemical products relating to mineral industry. The mechanicians may select for examination—(i) electrotechnics, or (ii) locomotives, or (iii) technology of textile machinery.

In the fifth year students spend at least one month in a factory, studying the branch of industry in which they are interested. They execute in the fifth year designs of a branch of industry, and work at material testing in the mechanical laboratory, etc., etc.

There are over 1,000 students in the Institute. The teaching and instructing staff numbers 65, viz.: Religious teacher, 1; professors, 13; assistant professors, 4; instructors, 40; formen of workshops, 7.

19. *Equipment of Higher Technological Institute, etc.*—The equipment is the following:—

(1) A library, with 35,000 volumes.
(2) Museum, machines, apparatus, models, commercial and other products, scientific collections.
(3) Physical cabinet and laboratory.
(4) Workshops, foundries, forges, pattern-making shop, metal-working shop.
(5) Mechanical laboratory for experimental research.
(6) Testing laboratory for materials of construction.
(7) Electrotechnical laboratory.
(8) Chemical laboratory.
(9) Laboratory for mineral technology, with furnaces and apparatus for the soda industry, chrome salts, prussiates of potash, ceramics, etc.
(10) Laboratory for dyeing and study of colouring matters.
(11) Laboratory for food products, with small distillery.
(12) Technical laboratory for fat, oil, naphtha, paper, leather, and similar industries.

This gives an idea of the scale of equipment. The budget of the Institute, including students fees, is about £28,000 annually.

The staff costs about £14,000 annually; the workshops, etc., cost about £4,100; the maintenance, assistance, heating, ventilation, etc., about £7,100.

The bursaries, etc., for a single year, amount to about £3,600 per annum. About one-third of the graduates of the Institute are employed on the railways. The others find their way to sugar refineries, engineering establishments, large chemical industries, textile industries, petroleum refineries, paper factories, metallurgical works, hydraulic services, etc. Some, also, enter the customs or inspectorial service, or become masters or directors of technical schools.

20. *Electro-technical Institute of Alexander III.*—This school is a higher school for the education of electrical engineers. It has a five-year course, open to students possessing the certificate of higher schools, of the gymnasium, etc. The fee is, roughly, £5 per annum (25 roubles per semester).

At the close of the course they become electrical engineers of the 1st or 2nd class according as they pass. Those who fail merely receive a certificate of study.

Electrical engineers who are not of noble rank, receive the rank of "notable citizen," and if they have a successful career of ten years' practical work, they may be made "hereditary notable citizens."

The

The courses are as shewn in the following programmes, viz.:—

PROGRAMME OF THE ELECTRO-TECHNICAL INSTITUTE OF ALEXANDER III, ST. PETERSBURG.

Subjects.	Year I—Hours per Week.		Year II—Hours per Week.		Year III—Hours per Week.	
	Courses and Lectures.	Laboratory Practice and Exercises.	Courses and Lectures.	Laboratory Practice and Exercises.	Courses and Lectures.	Laboratory Practice and Exercises.
Supplementary Mathematics	5	2	3	1	...	...
Descriptive Geometry	2	2	...	...	...	...
Mechanical theory of Heat	...	...	...	...	2	...
Rational Mechanics	2	1	2	½	2	1
Applied Mechanics (resistance of materials and details of the construction of machines)	...	...	3	...	...	...
Hydraulics	...	...	...	...	2	...
Mechanics of Construction	...	...	...	...	1	1
Laboratory practice (in testing of materials)	...	...	...	1	...	1
Mechanical Technology	...	...	2	...	...	...
Metal working	...	4	...	1	...	...
Physics	4	1	3	3	...	...
Chemistry and Chemical Analysis ...	3	...	2	4	...	4
Electro-chemistry (theoretical course)...	...	...	...	...	2	...
Electricity and Magnetism	...	..	...	...	3	...
Industrial Electricity	...	...	...	...	5	2
Electro-technical Projects	...	...	...	...	...	2
Construction of Electric Lines	...	...	...	...	1	...
Electric Telegraphs	...	...	...	...	2	1
Telephone and Electric Signals	...	...	...	...	1	...
Graphic works	...	4	...	2	...	...
Civil Construction	...	...	3	1	...	1
Topography	...	...	2	...	...	...
	16	14	20	13½	21	13

Subjects.	Year IV—Hours per Week.		Year V—Hours per Week.	
	Courses and Lectures.	Practical Work and Projects.	Courses and Lectures.	Practical Work and Projects.
Applied Mechanics, boilers, steam-engines, and other mechanical motors	6	3	...	3
Mechanics of Construction...	1	1	...	...
Industrial Electro-chemistry	1	1	...	3
Electric Stations	...	2	...	6
Construction of Electric Lines	2	...	...	3
Industrial Electricity	6	4	...	6
Electric Telegraphy	2	2	...	2
Generators for Telegraphy, receivers, stations	2	1	...	6
Telegraphic Projects	...	2	...	5
Telephony and Electric Signals	1	2	...	...
Telephonic Projects	...	...	...	3
Civil Constructions	...	...	...	2
Common and Special Law	...	...	2	...
Estimates and Technical Accountancy	...	...	...	2
	21	18	2	41

Besides the above, there are courses in languages, French, German, English, etc.
The recent buildings of the Institute cost about £100,000.

21. *General Remarks on Russian Higher Technical Education.*—The two examples given of higher technical education in Russia may be taken as characteristic of Russian ideas. Sufficient preliminary education is insisted on, and the courses are of five years' duration generally. This is the length of the course in the "Institute of Ways of Communication," (5) in section 16 of this chapter. The branches of study are:—Mathematics, including differential and integral calculus; descriptive geometry, and its applications; rational mechanics; physics; chemistry; geology and petrography; geodesy and topography; construction; technology of materials of construction; bridges, roads; railways, their construction, use, and rolling stock; interior navigation; maritime ports; canalisation, etc.; drainage and irrigation; architecture; heating and ventilation; applied mechanics, resistance of materials, stability of construction, theory of elasticity, hydraulics, thermodynamics, steam engines, locomotives, twisting machinery, hydraulic motors, applied electricity; administrative law; bookkeeping; drawing; languages; photography (optional).

The

The fees are about £10 per annum. About £25,000 per annum is the cost of this establishment.

The *Imperial School of Engineers of Moscow* differs somewhat in its organisation. It has a 3-year course, and then two seasons of practical work.

It will be seen that Russian technical education is of a very high order.

22. *Higher Technical Education in Sweden.*—Higher technical education, as seen by the Commissioners in Sweden, shewed the same advance as in other countries. The courses are well organised, and the laboratories finely equipped.

It will be sufficient to give an account of the work of the Polytechnicum of Stockholm. (*Kongl Tekniska Högskolan i Stockholm.*) This school has five professional divisions, viz.:—

I. School of machine construction and mechanical technology. (3 or 4-year course.)
II. School of chemical technology. (3-year course.)
III. Mining school, with 3 subdivisions, viz.:—
  (*a*) Mining mechanics. (4-year course.)
  (*b*) metallurgy and smelting, etc. (3 or 4-year course.)
  (*c*) Mining. (3 or 4-year course.)
IV. Architecture. 4-year course, or 3 years and 1 year in the Royal Academy of Fine Arts (*Kongl. Akademien för fria konsterna.*)
V. Roads and bridges engineering. (4-year course.)

There are ordinary and special pupils in the school. The ordinary or regular pupils must possess the Baccalaureat, and the higher sections of the modern secondary schools, or of the Latin sections, together with special qualification in mathematics, physics, and chemistry; failing these, candidates for admission must pass a special examination in mathematics, physics, chemistry, Swedish, German, English or French, history and geography. Irregular pupils are admitted after an examination to a limited number of courses. The instruction is gratuitous to ordinary pupils.

The Chalmer's Polytechnic (*Chalmer's Tekniska läroanstalt*) in Gothenburg has two divisions, viz., higher technical school and lower technical school. The higher division is organised very similarly to the Stockholm Polytechnic. The courses are of three years' duration in the higher school for mechanics, chemical technology, and architecture, and also naval architecture. In the lower school the courses are of two years' duration.

Associated with both institutions are institutes for the testing of materials.

23. *Detailed courses of the Technical High School of Stockholm.*—The following particulars of the programmes will shew more clearly the type of instruction. Throughout these programmes the two columns represent the hours per week in the winter and summer semesters. Where brackets are used the course is optional. The courses commence 11th September and last different periods. These are shewn in the programmes.

The various subdivisions of the programme are also shewn. For example, the Professional School of Mechanical Engineering and Mechanical Technology (*Fackskolan för maskinbyggnadskonst och mekanisk teknologi*) has courses—(1) for mechanical engineers and mechanical technologists (*för maskiningeniörer och mekaniska teknologer*); (2) for shipbuilders (*för skeppsbyggare*): for electro-technologists (*för electrotekniker*). The first and second years are the same for each, but the third and fourth differ.

24. *Mechanical Engineering Course.*—The programme in mechanical engineering is as follows:—

TECHNICAL HIGH SCHOOL OF STOCKHOLM.

Programme for Mechanical Engineers and Mechanical Technologists.

Subjects.	Hours per Week.	
	11 Sep.–22 Dec.	8 Jan.–10 June.
Year I.		
Pure Mathematics	9	10½
General Physics	4½	4½
General Chemistry	3	3
Mineralogy and Geology	...	(3)
Descriptive Geometry and Linear Drawing ...	7½	9
Freehand Drawing	4	3
Workshop Practice and Mechanical Laboratory ...	5	5
Totals	33	35
Year II.		
Pure Mathematics	3	...
Geodesy and Topography with drawing	...	4
Theoretical Mechanics (Higher Course)	10½	10½
Construction of Machine Details	13½	9½
General Theory of Building Construction	(1½)	(1½)
Statics of Construction	2½	...
Architecture	...	1½
Architectural Practice...	...	6½
Physical Laboratory...	2	2
Totals	31½	34

Subjects.	Hours per Week.				
	11 Sep.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 Mar.–30 April.	1 May–10 June.
Year III.					
Theory of Hydraulic Machinery	6	3	...	...	...
Construction of Hydraulic Machinery	12	13½	...	...	...
Theory of the Steam-engine	...	...	12	9	10½
Steam-engine Construction...	6	4½	5	5	...
Mechanical Technology	3½	6½	5	3	3
Properties of Metals	3	3	3½	2	2
Applied Heat	1½	1½	1½	1½	1½
Practical Exercises in same	...	...	2½	2½	2½
Electro-technics—Elementary	1½	1½	1½	1½	1½
Theory of Dam and Breakwater Construction	...	...	3	3	3
Technical Hygiene	...	...	(1½)	(1½)	(1½)
Totals	33½	33½	34	27½	24
Year IV (Optional).					
Theory of Hydraulic Machinery	10	10½	2	2	2
Theory of the Steam-engine	3	4½	1½	...	...
Steam-engine Construction	...	...	5½	6	6
Mining Mechanics	...	3	4½	4½	...
Mining Construction	...	...	7½	7½	...
Mechanical Technology, Factory Equipment	4	4	4	4	4
Properties of Metals	...	...	2½	2½	...
Statics of Construction	(4)	(4)	(4)	(4)	(4)
Technical Hygiene...	...	...	1½	1½	1½
Totals	21	26	36	32	17½

25. *Course for Shipbuilders.*—The course for shipbuilders, as already stated, is identical with that for mechanical engineers for Years I and II. The programmes for Years III and IV are as hereunder :—

Programme of Course for Shipbuilders, Stockholm.

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 March–30 April.	1 May–10 June.
Year III.					
Theory of Hydraulic Machinery	6	3	......	......	......
Construction of Hydraulic Machinery	7½	7½	......	......	......
Theory of the Steam-engine	6	4½	5	5	......
Steam-engine Construction	......	......	12	9	10½
Properties of Metals	3	3	3½	2	2
Mechanical Technology	1½	1½	1½	1½	1½
Applied Heat	1½	1½	1½	1½	1½
Electro-technics (Elementary)	1½	1½	1½	1½	1½
Naval Architecture...	9½	9½	9	12½	12½
Totals	36½	32	34	33½	29½
Year IV.					
Theory of Steam-engines	3	4½	1½	......	......
Steam-engine Construction	......	......	5½	6	9
Naval Architecture...	15½	15½	12	12	12
Properties of Metals	......	......	2½	2½	......
Mechanical Technology	2	2	4	4	4
Statics of Construction	(4)	(4)	(4)	(4)	(4)
Technical Hygiene	......	......	(1½)	(1½)	(1½)

26.

26. *Course of Electro-technology.*—Like the preceding, the courses in electro-technology for the first and second years are the same as for mechanical engineering. The courses for the third and fourth years are as hereunder:—

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 March–30 April.	1 May–10 June.
Year III.					
Theory of Hydraulic Machinery ...	6	3	......	......	......
Construction of Hydraulic Machinery ...	10½	10½	......	......	......
Steam-engine Theory ...	6	4½	5	5	......
Construction of Steam-engines ...	......	......	9	6	7½
Properties of Metals ...	3	3	3½	2	2
Mechanical Technology ...	1½	1½	1½	1½	1½
Applied Heat ...	1½	1½	1½	1½	1½
Electro-technics ...	6	6	7½	4½	4½
Electro-technical Practice ...	2	2	4	10	10
Theory of Dam and Breakwater Construction ...	......	......	3	3	3
Totals ...	36½	32	35	33½	30
Year IV (Optional).					
Theory of Hydraulic Machinery ...	8	8	......	......	......
Theory of Steam-engines ...	3	4½	1½	......	......
Construction of Steam-engines ...	......	......	5½	6	6
Electro-technical Practice ...	6	6	6	10	10
Statics of Construction ...	(4)	(4)	(4)	(4)	(4)
Technical Hygiene ...	......	......	1½	1½	1½

27. *Professional School for Chemical Technology.*—The three-year course in chemical technology is organised as follows:—

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 March–14 May.	14 May–10 June.
Year I.					
Pure Mathematics ...	9	9	......	......	......
Theoretical Mechanics (Elementary) ...	......	......	7½	7½	7½
General Physics ...	4½	4½	4½	4½	4½
General Chemistry ...	3	3	3	3	3
Mineralogy and Geology ...	......	......	3	3	3
Descriptive Geometry and Linear Drawing ...	7½	7½	7½	7½	7½
Freehand Drawing ...	4	4	3	3	3
Workshop Practice and Mechanical Laboratory ...	5	5	5	5	5
Totals ...	33	33	33½	33½	33½
Year II.					
Geodosy and Topography, with Drawing...	......	......	4	4	......
Descriptive Mechanics ...	4½	4½	......	......	......
Machine Construction ...	9	6	5	......	......
General Chemistry ...	3	3	3	3	......
Analytical Chemistry ...	1½	1½	1½	1½	......
Chemical Laboratory ...	10	15	10	12½	......
Mineralogy and Geology ...	......	3	3	......	......
Practical Exercises ...	......	......	......	5	......
Architecture ...	......	......	1½	1½	......
Practical Exercises ...	......	......	3	3	......
Physical Laboratory ...	2	2	2	......	......
Totals ...	30½	35	33	30½	......
Year III.					
Mechanical Technology ...	1½	1½	1½	1½	1½
Applied Heat ...	1½	1½	1½	1½	1½
Electro-technics (Elementary) ...	1½	1½	1½	1½	1½
Chemical Technology ...	4½	4½	4½	4½	4½
Chemical Laboratory ...	18	18	20	20	20
Technical Hygiene ...	1½	1½	1½	1½	1½
Electro-chemistry ...	1½	1½	3½	3½	3½
Zymotechnics ...	......	......	(3)	(3)	(3)
Totals ...	30	30	34	34	34

28.

28. *Professional School of Mining and Mining Mechanics.*—The four-year course in Mining Science with a subdivision for Mining Mechanics, is organised as follows :—

Subjects.	Hours per Week.	
	11 Sept.–22 Dec.	8 Jan.–10 June.
Year I.		
Pure Mathematics	9	$10\frac{1}{2}$
General Physics	$4\frac{1}{2}$	$4\frac{1}{2}$
General Chemistry	3	3
Mineralogy and Geology	......	3
Descriptive Geometry and Linear Drawing	$7\frac{1}{2}$	9
Freehand Drawing	4	3
Workshop Practice in Mechanical Laboratory ..	5	5
Totals	33	38
Year II.		
Pure Mathematics	3	......
Geodesy and Topography, with Drawing	......	4
Theoretical Mechanics (Higher Course)	$10\frac{1}{2}$	$10\frac{1}{2}$
Construction of simple parts of Machines	$13\frac{1}{2}$	$9\frac{1}{2}$
Chemical Laboratory	6	......
General Theory of Construction	$(1\frac{1}{2})$	$(1\frac{1}{2})$
Statics of Construction, with Practice	$2\frac{1}{2}$	$1\frac{1}{2}$
Architecture	......	$1\frac{1}{2}$
Architectural Practice	......	$6\frac{1}{2}$
Totals	$35\frac{1}{2}$	$33\frac{1}{2}$

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 Mar.–30 April.	1 May–10 June.
Year III.					
Theory of hydraulic machinery	6	3	......	......	......
Construction of hydraulic machinery	$10\frac{1}{2}$	$10\frac{1}{2}$	......	......	......
Theory of Steam Engines	6	$4\frac{1}{2}$	5	5	......
Steam Engine Construction	......	......	11	8	$9\frac{1}{2}$
Mechanical Technology	2	5	$3\frac{1}{2}$	$3\frac{1}{2}$	$1\frac{1}{2}$
Properties of metals	3	3	$3\frac{1}{2}$	2	2
Chemical Laboratory	......	......	4	4	4
Applied Heat	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Practical Exercises in Applied Heat	......	......	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
Electro-technics (Elementary)	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Statics of Construction, with Practice	4	4	......	......	......
Theory of dams, break-waters, etc.	......	......	3	$1\frac{1}{2}$	$1\frac{1}{2}$
Construction of same	......	......	......	3	3
Totals	$34\frac{1}{2}$	33	$35\frac{1}{2}$	$32\frac{1}{2}$	27
Year IV.					
Hydraulic Machinery, theory and construction... ...	$8\frac{1}{2}$	7	......	......	......
Steam Engine	3	$4\frac{1}{2}$	......	......	......
Mining Mechanics	......	3	$4\frac{1}{2}$	$4\frac{1}{2}$	......
Mining Construction	......	......	9	9	......
Chemistry of Mining	3	$1\frac{1}{2}$	......	......	......
Metallurgy of Iron	$4\frac{1}{2}$	6	6	$7\frac{1}{2}$	......
Metallurgical Construction	......	......	......	$4\frac{1}{2}$	......
Metallurgical Laboratory	$4\frac{1}{2}$	3	3	3	......
Mining Science	$4\frac{1}{2}$	$4\frac{1}{2}$	3	3	......
Practical Exercises in Mining	6	6	$7\frac{1}{2}$	5	......
Totals	34	$35\frac{1}{2}$	33	$36\frac{1}{2}$	......

29. *Professional School for Mining and Metallurgy.*—The four-year course in Mining Science, with a subsection for Metallurgy, etc., has the first year's work as in the preceding, excepting that the workshop practice is optional. The second, third, and fourth years are as follow :—

Subjects.	Hours per Week.			
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 Mar.–14 May.[1]
Year II.				
Pure Mathematics	3	3	......	......
Geodesy and Topography, with Drawing	......	......	4	4
Theoretical Mechanics (Higher Course)	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$
Construction of simple parts of Machines	9	9	6	3
Analytical Chemistry	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Chemical Laboratory	11	6	$5\frac{1}{2}$	$5\frac{1}{2}$
Mineralogy and Geology	......	3	3	3
Practical Exercises therein	......	......	......	5
Architecture	......	......	$1\frac{1}{2}$	$1\frac{1}{2}$
Practical Exercises in Architecture	......	......	3	3
Totals	35	33	35	37
Year III.				
Theory of hydraulic machinery	6	3	......	......
Construction of hydraulic machinery	5	$6\frac{1}{2}$	......	......
Steam Engine Theory	6	$4\frac{1}{2}$	5	......
Steam Engine Construction	......	......	4	$5\frac{1}{2}$
Mechanical Technology	......	3	$1\frac{1}{2}$	$1\frac{1}{2}$
Properties of Metals	3	3	......	2
Applied Heat	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Practical Exercises in Applied Heat	......	......	$2\frac{1}{2}$	$2\frac{1}{2}$
Electro-technics (Elementary Course)	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Chemical Laboratory	11	9	14	$13\frac{1}{2}$
Mineralogy	......	(2)	(3)	(3)
Electro-chemistry	$(1\frac{1}{2})$	$(1\frac{1}{2})$	$(1\frac{1}{2})$	$(1\frac{1}{2})$
Totals	34	32	30	28
Year IV.				
Mining Mechanics	......	3	$4\frac{1}{2}$	$4\frac{1}{2}$
Mining Construction	......	......	9	9
Mining Chemistry	3	3	......	......
Metallurgy of Iron	$4\frac{1}{2}$	6	6	$7\frac{1}{2}$
Metallurgical Construction...	......	......	......	$4\frac{1}{2}$
Metallurgy of other metals...	......	......	3	3
Metallurgical Laboratory	22	$18\frac{1}{2}$	$10\frac{1}{2}$	6
Mining	$4\frac{1}{2}$	$4\frac{1}{2}$	3	3
Totals	34	35	36	$37\frac{1}{2}$

[1] Third year up to 10th June; fourth year up to 30th April.

In

In the *three-year course* the first year is the same as the first year in Chemical Technology.

Subjects.	Hours per Week.			
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 Mar.–14 May.[1]
Year II.				
Geodesy and Topography, with Drawing	......	......	4	4
Descriptive Mechanics	4½	4½	......	......
Machine Construction	9	8	5	......
Applied Heat	1½	1½	1½	1½
Electro-technics (Elementary)	1½	1½	1½	1½
Analytical Chemistry	1½	1½	1½	1½
Chemical Laboratory	12	11	10	13
Mineralogy and Geology	......	3	3	3
Practical Exercises in same	......	......	......	5
Architecture	......	......	1½	1½
Practical Exercises in same	......	......	3	3
Electro-chemistry	(1½)	(1¼)	(1½)	(1½)
Totals	30	30	31	34

The third-year course is the fourth-year course in the preceding programme.

30. *Professional School of Practical Mining.*—The first and second years are identi:al with those of the four-year course of the previous programme for four-year course in Mining and Metallurgy. The third and fourth years are as hereunder:—

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–28 Feb.	1 Mar.–30 April.	8 May–10 June.
Year III.					
Geodesy, with Drawing	......	......	......	(4½)	(4½)
Theory of hydraulic machinery	6	3	......	......	......
Construction of hydraulic machinery	5	6½	......	......	......
Theory of Steam Engine	6	4½	5	5	......
Steam Engine Construction	......	......	4	4	5½
Applied Heat	1½	1½	1½	1½	1½
Practical Exercises in same	......	......	2½	2½	2½
Electro-technics (Elementary)	1½	1½	1½	1½	1½
Chemical Laboratory	11	6	12	12	13½
Mineralogy, with Practice	......	5	6½	6½	4
Totals	31	28	33	33	28½
Year IV.					
Mining Mechanics	......	3	4½	4½	......
Mining Construction	......	......	9	9	......
Mining Chemistry	3	3	......	......	......
Metallurgy of Iron	4½	6	6	7½	......
Metallurgical Construction	......	......	......	4½	......
General Metallurgy	......	......	3	3	......
Metallurgical Laboratory	18½	12½	3	6	......
Mining Theory	4½	4½	3	3	......
Practical Exercises in Mining	6	6	7½	......	......
Totals	36½	35	36	37½	......

In the three-year course, the first year is the same as for Chemical Technology, the second year the same as in the three-year course in Mining and Metallurgy, and the third year the same as the fourth year 31.
in the Practical Mining four-year course.

[1] Third year up to 10th June; fourth year up to 30th April.

31. *Professional School of Architecture.*—The four-year course in Architecture is developed as in the programme hereunder:—

Subjects.	Hours per Week. 11 Sept.–22 Dec.	Hours per Week. 8 Jan.–25 Feb.	Hours per Week. 1 May–10 June.
Year I.			
Pure Mathematics	9	......	......
Theoretical Mechanics (Elementary Course)	......	7½	7½
General Physics	4½	4½	4½
General Chemistry	3	3	3
Mineralogy and Geology	......	3	3
Descriptive Geometry and Linear Drawing	9	9	9
Freehand Drawing	5	3	3
Workshop Practice and Mechanical Laboratory	(5)	(5)	(5)
Totals	30½	30	30
Year II.			
Geodesy and Topography, with Drawing	......	4	4[1]
Descriptive Mechanics	4½	......	......
Applied Heat	1½	1½	1½
General Theory of Building Construction	1½	1½	1½
Practical Exercises in same	......	2½	4
Statics of Construction, with Practice	2½	1½	1½
Architecture	3	......	......
Practical Exercises in same	7½	8	8
Descriptive Geometry and Linear Drawing	3½	......	......
Ornamental Drawing	......	4	2
Freehand Drawing	5	4½	4½
Modelling	5	5	5
Totals	34	32½	32
Year III.			
Statics of Construction, with Practice	6	6	6
Special Course in Theory of Building Construction ...	......	1½	1½
General Architecture	3	4½	4½
Practical Exercises therein	12	12½	12½
Ornamental Drawing	5½	4	4
Modelling	5	5	5
Technical Hygiene	......	1½	1½
Totals	31½	35	35
Year IV.			
General Architecture	1½	1½	1½
Practice in same	12	13	13
Theory of Building Construction (Special Course) ...	1½	......	......
History of Architecture	1½	1½	1½
Ornamental Drawing...	6½	7	7
Mechanical Laboratory	2	2	2
Totals	25	25	25

[1] Up to 14th May only, for the whole column.
[2] Up to 15th April only, for the whole column.

32. *Professional School of Hydraulic Construction.*—The four-year course of professional instruction in Hydraulic Engineering is organised as indicated in the following programmes:—

Subjects.	Hours per Week.	
	11 Sept.–22 Dec.	8 Jan.–10 June.
Year I.		
Pure Mathematics	9	10½
General Physics	4½	4½
General Chemistry	3	3
Mineralogy and Geology	......	3
Descriptive Geometry and Linear Drawing	7½	9
Freehand Drawing	5	3
Workshop Practice in Mechanical Laboratory ..	(5)	(5)
Totals	29	33
Year II.		
Pure Mathematics	3	..... [1]
Geodesy and Topography, with Drawing	......	4
Theoretical Mechanics (Higher Course)	10½	10½
Construction of Machine Details	5½	6
General Theory of Construction, with Practice ...	1½	5½
Statics of Construction, with Practice...	2½	1½
Architecture	3	......
Practical Exercises in same	6	6½
Descriptive Geometry and Linear Drawing	3½	......
Totals	35½	34

Subjects.	Hours per Week.				
	11 Sept.–31 Oct.	1 Nov.–22 Dec.	8 Jan.–25 Feb.	1 Mar.–30 April.	1 May–10 June.
Year III.					
Geodesy, with Drawing	......	......	2½	1½	4½
Steam Engine Theory	6	4½	2	2	......
Steam Engine Construction	......	......	3	3	3
Applied Heat	(1½)	(1½)	(1½)	(1½)	(1½)
Electro-technics (Elementary)	(1½)	(1½)	(1½)	(1½)	(1½)
Telegraphy and Telephony...	1½	1½	1½	1½	1½
General Theory of Construction	1½	1½	......	......	......
Statics of Construction, with Exercises	6	6	4	4	4
Architecture...	......	......	1½	1½	......
Practical Exercises in same	3	3	3	3	3
Hydraulics	4½	4½	6	6	6
Hydraulic Construction	9	9	8½	11	11
Technical Hygiene	......	......	......	1½	1½
Totals	31½	30	32	35	34½
Year IV.					
Geodesy and Topography, with Drawing...	7½	......	...... [2]	......	......
General Architecture	3½	1½	......	......	......
Practical Exercises in same	6	6	3	......	......
History of Architecture	1½	1½	1½	......	......
Hydraulics	4½	4½	4½	......	......
Hydraulic Construction	6	9	12½	......	......
Mechanical Laboratory	2	2	2	......	......
Totals	29	24½	23½	......	......

[1] This ends on 14th May instead of 10th June.
[2] From 8th January to 15th April.

33. *General Remarks on Swedish Technical Education.*—The Technical High School of Stockholm has a considerable staff of professors, lectors, extra-teachers, dozents, and assistants. As already pointed out, it demands thorough preparation before the course is entered upon, and the courses are of an advanced character. In Pure Mathematics, for example, in the first-year's course the following are taken :—Analytical geometry, elements of the differential calculus, theory of equations with determinants, integral calculus, geometrical illustrations of the differential and integral calculus. In the second year, differential equations of the first and second order, elements of least squares. As the programmes shew, a considerable time is spent in the laboratories, which are adequately equipped for the purpose. At the time of the Commissioner's visit, special attention was being paid to hydraulic engineering. The whole of the equipment seen by the Commissioner was excellent.

34. *Concluding Remarks.*—The preceding chapters on Technical Education in Europe could, if space permitted, be indefinitely extended, but sufficient has perhaps now been given to fairly well disclose the state of organisation of technical education throughout Europe and in America.

It is at once obvious, that though the variety of organisation is great, stress is everywhere laid upon adequate preparation. It was equally evident to the Commissioner that strenuous efforts were being made to so equip the laboratories that original research would be carried on, the theoretical instruction amply demonstrated, and a considerable amount of practical work undertaken by the students.

In all cases the services of properly educated teachers are requisitioned. The technical high schools are without exception Universities, and importance is attached to initiative and original research as in the University. The opportunity for research, however, is less conspicuous, owing to the time consumed in technical and professional exercises.

CHAPTER XXXV.

CHAPTER XXXV.

Higher Technological Education in the United States.

[G. H KNIBBS.]

1. *Introduction.*—The provision in America made for higher technical education is on a colossal scale, and its features shew a certain independence of development which have commanded world-wide attention. As far back as 1893, Professor A. Riedler, a distinguished engineer in the "*Technische Hochschule zu Berlin,*"[1] reported on these in a "*Bericht*" entitled "*Amerikanische technische Anstalten.*"[2] At the time Professor Riedler reported for the Prussian Government, there were fifty-two important institutions teaching engineering, a list of which is given in the next section. The review of the type of work then done was taken into account in the development of the higher technical schools of Germany; and, as a matter of fact, a feature of German and American technical education is the quick reaction of one on the other. Americans visit Germany educationally, and, conversely, Germans similarly visit America.

2. *Provision made for Technical Education in the United States.*—The provision existing in 1893 for instruction in engineering alone was as is shewn hereunder. The list is given in the order of the dates of foundation. These have been considerably augmented in number since, as the following list for ten years later will shew:—

No.	Date.	Subject.[3]	Institution.	Place.
1	1824	C.	Rensselaer Polytechnic Institute	Troy, N.Y.
2	1845	C.	Union College, School of Civil Engineering... ...	Schenectady, N.Y.
3	1846	C.E.	Harvard University, Lawrence Scientific School ...	Cambridge, Mass.
4	1847	C.M.E.	Yale University, Sheffield Scientific School... ...	New Haven, Conn.
5	1851	C.	Dartmouth College, Chandler School of Science ...	Hanover, N.H.
6	1852	C.M.Mg.E.	University of Michigan, Engineering Department...	Ann Arbor, Mich.
7	1854	C.	Polytechnic Institute of Brooklyn	Brooklyn, N.Y.
8	1862	M.	Kansas State Agricultural College, Mechanical Department.	Manhattan, Kan.
9	1864	C.M.Mg.E.	Columbian College, School of Mines...	New York, N.Y.
10	1864	C.E.	Rutgers College, Scientific School	New Brunswick.
11	1865	C.M.Mg.E.	Massachusetts Institute of Technology ...	Boston, Mass.
12	1866	C.M.Mg.E.	Lehigh University, Engineering Department ...	Bethlehem, Pa.
13	1866	C.B.	Lafayette College, Pardee Scientific Department ...	Easton, Pa.
14	1866	C.	University of Vermont, Engineering Deparment ...	Burlington, Vt.
15	1866	C.B.	Washington and Lee University, Engineering School	Lexington, Va.
16	1867	C.M.	University of Georgia, School of Engineering ...	Athens, Ga.
17	1867	C.	Dartmouth College, Thayer (grad.) School of Civil Engineering.	Hanover, N.H.
18	1867	C.M.Mg.E.	University of Illinois, College of Civil Engineering...	Urbana, III.
19	1868	C.M.	Pennsylvania Military Academy	Chester, Pa.
20	1868	C.M.Mg.	University of Virginia, Engineering Department ..	Charlottesville, Va.
21	1868	C.	Cornell University, College of Civil Engineering ...	Ithaca, N.Y.
22	1868	C.M.E.	Tufts College, Engineering Department	Medford, Mass.
23	1868	C.M.E.	Worcester Polytechnic Institute	Worcester, Mass.
24	1868	C.M.E.	Iowa State College, Agricultural and Mechanical Arts	Ames, Ia.
25	1868	C.M.Mg.	University of California, Engineering Department...	Berkeley, Cal.
26	1869	C.M.	Maine State College, Agricultural and Mechanical Arts	Orono, Me.
27	1869	C.	Swarthmore College, Engineering Department ...	Swarthmore, Pa.
28	1869	C.M.E.	University of Minneapolis, College of Mechanics and Arts.	Minneapolis, Mim.
29	1870	C.M.G.	Washington University, Polytechnic School ...	St. Louis, Mo.
30	1870	M.	Stevens Institute of Technology	Hoboken, N.J.
31	1870	M.	Cornell University, Sibley (M.E.) College	Ithaca, N.Y.
32	1871	C.B.	University of Missouri, School of Mines	Rolla, Mo.
33	1871	C.M.	State Agricultural and Mechanical College of Texas	College Station, Texas.
34	1872	C.Mg.E.	Alabama Polytechnic Institute	Auburn, Ala.
35	1872	C.M.Mg.	University of Penna., Towne Scientific School ...	Philadelphia, Pa.
36	1872	C.M.Mg.E.	University of Wisconsin, College of Mechanics and Engineering.	Madison, Wis.
37	1873	C.E.	University of Kansas, Engineering Department ...	Lawrence, Kan.

[1] It may be here mentioned that the Commissioners are under the greatest obligations to Professor Riedler for his kindness; not only in giving them introductions to distinguished technologists and educationists, but also in affording them personally an immense amount of information.

[2] Leonhard Simion. Berlin, 1893, pp. 381-459.

[3] In the above, "C.," "M.," "E.," "Mg." stand for Civil, Mechanical, Electrical, and Mining respectively.

2. *Provision made for Technical Education in the United States—continued.*

No.	Date.	Subject.	Institution.	Place.
38	1873	C.E.	State University of Iowa, Department of Engineering	Iowa City, Ia.
39	1873	C.	Cornell College (Iowa), Department of Civil Engineering.	Mt. Vernon, Ia.
40	1873	C.E.	College of New Jersey, J. C. Green School of Science	Princeton, N.J.
41	1874	C.E.	University of Cincinnati, Engineering Course ...	Cincinnati, O.
42	1874	M.Mg.	Colorado State School of Mines	Golden, Colo.
43	1874	C.M.E.	Pennsylvania State College, Engineering Department	State College, Pa.
44	1874	C.M.Mg.E.	Purdue University, School of Engineering	Lafayette, Ind.
45	1874	C.M.E.	Rose Polytechnic Institute	Terre Haute, Ind.
46	1879	C.M.	Western University of Pennsylvania, Engineering Department.	State College, Pa.
47	1880	C.M.E.	University of Nebraska, Engineering Department...	Lincoln, Neb.
48	1884	C.	University of Texas, Engineering Department ...	Austin, Tex.
49	1885	Mg.	Michigan Mining School	Houghton, Mich.
50	1885	M.	State Agricultural College of Michigan, Mechanical Department.	Agr. College, Mich.
51	1888	C.M.	Georgia School of Technology	Atlanta, Ga.
52	1888	Mg.	Montana School of Mines	Deer Lodge, Mont.

In the above, "C," "M," "E," "Mg." stand for Civil, Mechanical, Electrical, and Mining, respectively.

The existing institutions in which agriculture, civil, mining, mechanical, electrical, and chemical engineering, and architecture are taught are as in the table hereunder, in which "A." stands for Agriculture, "Ch." for Chemical Engineering, and "Ar." for Architecture.

List of Institutions giving Higher Technical Education in the United States of America.

No.	State and Institution.	Courses.	No.	State and Institution.	Courses.
	Alabama—			Kentucky—	
1	Howard College	C.	22	Berea College	A.
2	University of Alabama	C.	23	Central University, Kentucky ...	C.E.Ch.
	Arizona—		24	Agricultural and Mechanical College, Kentucky	A.M.C.
3	University of Arizona	M.C.Ch. Mg.		Louisiana—	
	Arkansas—		25	Louisiana State University ...	A.M.C.Ch.
4	University of Arkansas... ...	A.M.C.E.	26	Tulane University	M.C.Ch.
	California—			Maine—	
5	University of California ...	A.M.C.Ch. Mg.	27	University of Maine	A.M.C.E.
6	Throop Polytechnic Institute ...	C.E.Ch.		Maryland	
7	Leland Stanford Junior University	M.C.E.	28	St. Hohn's College	M.
	Colorado—		29	Maryland Agricultural College...	A.M.C.
8	University of Colorado	C.E.		Massachusetts—	
	Connecticut—		30	Harvard University	A.M.C.E. Ch.Mg.Ar.
9	Yale University...	M.C.E.	31	Tufts College	M.C.E.
	Delaware—			Michigan—	
10	State College for Coloured Students	C.	32	University of Michigan ...	M.C.E.Ch.
11	Delaware College	C.E.		Minnesota—	
	Florida—		33	St. John's University	M.
12	Florida State Agricultural College	A.M.	34	University of Minnesota ...	A.M.C.E. Ch. Mg.
	Georgia—			Mississippi—	
13	University of Georgia	A.C.E.	35	University of Mississippi ...	C.E.
14	North Georgia Agricultural College	A.		Missouri—	
	Idaho—		36	University of State of Missouri	A.M.C.E. Ch. Mg.
15	University of Idaho	C.Mg.	37	Washington University ...	M.C.E.
	Illinois—			Nebraska—	
16	University of Illinois	A.M.C.E. Ar.	38	University of Nebraska... ...	A.M.C.E.
	Indiana—			Nevada—	
17	University of Notre Dame ...	M.C.E.	39	Nevada State University ...	A.M.C.Mg.
18	Earlham College...	C.		New Hampshire—	
	Iowa—		40	Dartmouth College	C.
19	State University of Iowa ...	C.		New Jersey—	
20	Cornell College	C.	41	Rutgers College	A.C.E Ch.
	Kansas—		42	Princetown University	C.E.
21	University of Kansas	M.C.E.Ch. Mg.			

List of Institutions giving Higher Technical Education—continued.

No.	State and Institution.	Courses.
	New York—	
43	Polytechnic Institute, Brooklyn...	M.C.E.Ch. Ar.
44	Cornell University	A.M.C.Ar.
45	Columbia University	M.C.E.Mg. Ar.
46	Manhattan College	C.
47	New York University	C.
48	Union College	C.
49	Syracuse University	M.C.E.Ar.
	North Carolina—	
50	University of North Carolina	Mg.
	North Dakota—	
51	University of North Dakota	M.E.Mg.
52	Red River Valley University	M.
	Ohio—	
53	Ohio University...	E.
54	University of Cincinnati	M.C.
55	Ohio State University	A.M.C.E. Ch.Mg.Ar.
	Oklahoma—	
56	University of Oklahoma	C.
	Oregon—	
57	University of Oregon	M.C.E.Ch. Mg.
	Pennsylvania—	
58	West University, Pennsylvania	M.C.E.Ch.
59	Pennsylvania Military College...	C.
60	Lafayette College	C.E.Ch.Mg.
61	Grove City College	M.C.
62	Haverford College	M.
63	Allegheny College	C.
64	University of Pennsylvania	M.C.E.Ch. Ar.
65	Pennsylvania State College	A.M.C.E. Mg.
66	Lehigh University	M.C.E.Mg.
67	Swarthmore College	M.
68	Washington and Jefferson College	C.

No.	State and Institution.	Courses.
	Rhode Island—	
69	Brown University	M.C.E.
	South Carolina—	
70	South Carolina College ...	C.E.
	South Dakota—	
71	University of South Dakota	C.
	Tennessee—	
72	University of Tennessee	A.M.Ch.
73	Cumberland University	C.
74	Vanderbilt University ...	M.C.
75	University of the South	E.
	Texas—	
76	University of Texas	C.
	Utah—	
77	University of Utah	M.
	Vermont—	
78	University of Vermont and State Agricultural College ...	A.M.C.E. Ch.C.
79	Norwich University	C.
	Virginia—	
80	University of Virginia ...	M.C.
	Washington—	
81	University of Washington	M.C.E.Mg.
	West Virginia—	
82	West Virginia University	A.M.
	Wisconsin—	
83	University of Wisconsin	A.M.C.E.
	Wyoming—	
84	University of Wyoming	A.M.Mg.

For completeness of equipment, probably the Massachusetts Institute of Technology stands unrivalled in the United States. A chapter, therefore, has been devoted to a description of its origin, aim, and work.

In this chapter, technical courses have been selected almost at random. They will give, however, some idea of the type of provision made in America for higher technical education.

3. *Technical Courses, Washington University.*—The Washington University has the following departments or faculties, viz. :—

I. An Undergraduate Department, including a college and school of engineering.
II. The Henry Shaw School of Botany.
III. The St. Louis School of Fine Arts.
IV. The St. Louis Law School.
V. The Medical Department.
VI. The Missouri Dental College.

Besides these there have been organised, under the charter of the University, the following schools, viz. :—

(1.) The Smith Academy. (2.) The Mary Institute. (3) The Manual Training School.

The courses of instruction provided in the Undergraduate Department include Greek, Latin, English, German, French, Mental Philosophy, Economics, History, History of Arts, Mathematics, Applied Mechanics, Physics, Chemistry, Botany, Astronomy, Zoology, Geology, Drawing, Civil Engineering, Mechanical Engineering, Electrical Engineering, Anatomy, Histology, Physiology, Pathology, and Bacteriology, Hygiene, and Forensic Medicine.

It will suffice to refer to the schools in Art and in Engineering.

4. *St. Louis School of Fine Arts, Washington University.*—Originating in 1875, this school was fully organised in 1879, its object being to afford instruction in the Fine Arts, the collection and exhibition of pictures, statuary, and other works of art, etc.; the promotion of æsthetic and artistic education.

Students are admitted at any time, since the instruction is individual, and admission depends merely upon proof of skill.

There are *morning classes* as follows :—

Study of the antique; life class, nude and draped; ceramic painting; composition in colour; composition and illustration in black and white; artistic anatomy; sketch class in black and white; perspective.

The

The *afternoon classes* are—

Painting from the head; from still life; ceramic painting; design and applied art; modelling; teachers' course.

The *evening classes* are—

Elementary antique; advanced antique; life class, nude; modelling *mechanical drawing*; *architectural drawing.*

The *Saturday classes* are as follows—

Juvenile class; illustration in black and white; advanced class; illustration and sketching in colour; teachers' course; out-door sketching, landscape and figure.

As it is not the purpose of this chapter to discuss art instruction, this will be a sufficient reference to the above. It will be noticed that the technical drawing is under the ægis of the Art School.

5. *The School of Engineering and Architecture Department, Washington University.*—Students may enter either on Certificate or by Examination. The graduates of eighteen of such High Schools of America as are approved by the Faculty are admitted without examination. All candidates are required to furnish testimonials of good moral character, and students from other collegiate institutions, who expect to enter in advance of the Freshman Class, are required to present certificates of honourable dismissal. The following are the subjects for the Entrance Examination:—The Elements of English, Algebra, Elementary, Plane, and Solid Geometry, the French, German, Spanish and Latin languages, History and Elementary Physics.

The courses of study are—

I. Civil Engineering.
II. Mechanical Engineering.
III. Electrical Engineering.
IV. Chemical Engineering.
V. Science and Literature.
VI. Architecture.

Reference will be made to the work of these several branches.

6. *Civil Engineering, Washington University.*—The four-year course in Civil Engineering is developed as follows:—

PROGRAMME OF STUDIES IN CIVIL ENGINEERING, WASHINGTON UNIVERSITY, UNITED STATES, AMERICA.

FRESHMAN YEAR.

First Term.	Hrs. per Week.
English, Composition...	3
Elementary Course in German, *or*	3
" " " French	3
Mathematics—	
Higher Algebra...	3
Plane Trigonometry	2
General Descriptive Chemistry—	
Two Lectures ... 2 hrs.; Laboratory Practice ... 2 hrs.	4
Freehand Drawing	6
Drawing: Instrumental and Lettering	3
Shop: Wood-working	(?)

Second Term.	Hrs. per Week.
English: Forms of Prose	3
Elementary Course in German, *or*	3
" " " French	3
Mathematics—	
Spherical Trigonometry...	1
Analytical Geometry	3
Physics: Elementary Mechanics—	
Two Lectures or Recitations... 2 hrs.; Laboratory Practice... 2 hrs.	4
Descriptive Chemistry—	
Two Lectures ... 2 hrs.; Laboratory Practice ... 2 hrs.	4
Geometrical Drawing and Lettering	4
Shop: Pattern Work and Moulding	(?)

SOPHOMORE YEAR.

First Term.	Hrs. per Week.
German: Reading, Composition, etc., *or*	3
French, Reading, Composition, etc....	3
Mathematics—	
Analytical Geometry	3
Descriptive Geometry—	
Two Lectures ... 2 hrs.; Drawing ... 2 hrs.	4
Physics: Heat and Light—	
Three Lectures or Recitations... 3 hrs.; Laboratory Practice ... 3 hrs.	6
Chemistry: Qualitative Analysis ...	6
Mechanical Drawing and Lettering...	6
Shop: Forge and Machine Work	(?)

Second Term.	Hrs. per Week.
Civil Engineering: Elementary Surveying—	
Two Recitations ... 2 hrs.; Field Practice ... 6 hrs.	8
Mathematics—	
Differential Calculus	3
Descriptive Geometry—	
Two Lectures ... 2 hrs.; Drawing ... 2 hrs.	4
Mechanics: Statics ...	
Physics: Electricity and Magnetism—	
Three Lectures or Recitations 3 hrs.; Laboratory Practice ... 3 hrs.	6
Shop: Machine Work	(?)

JUNIOR YEAR.

First Term.	Hrs. per Week.
Civil Engineering—	
Stereotomy—	
One Recitation ...1 hr.; Drawing ...3 hrs.	4
Higher Surveying	3
Drawing...	9
Electric Machinery—	
Two Recitations ...2 hrs.; Field Practice ...6 hrs.	8
Mathematics: Integral Calculus	3
Mechanics: Distribution of Stress ...	(?)
Physics: Electrical Measurements ...	6

Second Term.	Hrs. per Week.
Civil Engineering—	
Stresses in Framed Structures...	3
Structural Drawing	9
Testing Laboratory Practice	6
Contracts and Specifications	1
Mechanical Engineering: Elementary Steam Engineering	3
Mechanics: Unbalanced Forces	(?)

SENIOR

SENIOR YEAR.

First Term.	Hrs. per Week.
Civil Engineering—	
Hydraulics	3
Designing of Framed Structures ...	3
Structural Design	9
Water and Sewerage Systems	3
Mechanics: Deflection and Torsion... ...	(?)
Elective (One to be chosen):—	
(a) Civil Engineering – Railway Engineering (three lectures)	3
(b) Road Engineering (three lectures)...	3
(c) Economics, Transportation, etc. ...	(?)
(d) Physics: Mathematical Theory of Electricity	3
(e) Astronomy, Descriptive	3
(f) Botany: Bacteriology	(?)

Second Term.	Hrs. per Week.
Civil Engineering—	
Masonry Structures, Tunnelling, and Explosives	3
Engineering Design	[illegible]
Graduation Thesis	...
Mechanics: Kinematic and Mechanism ...	(?)
Practical Astronomy...	3
Elective (One to be chosen)—	
(a) Civil Engineering: Water and Sewerage Purification (three lectures)	3
(b) Suspension, Cantalever, Arch and Lift Bridges (three lectures) ...	3
(c) Steel Framework of Buildings: Combination Construction (three lectures)	3
(d) Harbours, Rivers and Canals (three lectures)	3
(e) Geology, General Course	(?)

The equipment consists of, for the Freshman and Sophomore years, the libraries and other apparatus of the several departments in which their courses are given. The equipment of the Manual Training School is utilized for the shop work. There are also models and drawings, a working library, surveying instruments, and a testing laboratory.

As the length of time spent in surveying so completely differs from that devoted to the subject in the similar course in the University of Sydney, some reference may be made thereto.

The elementary surveying comprises the use and adjustment of all the ordinary surveying instruments, land surveying, problems in linear surveys, in laying out railway curves, etc., topographical surveying by the transit and stadia method and also by the plane table. Two recitations and *six hours field practice a week* are devoted thereto.

To *surveying in the field*, three weeks are continuously devoted. This practice includes the topographical survey of a considerable tract of ground with an irregular surface, for the purpose of mapping it with 5-foot contours, the survey being based on a system of triangulation and levels which form a part of the work of the survey. A hydrographic survey, with locations by one of the most approved methods, is made, and a railroad line is also located from a contour map which is made in the field, and the earth-work upon it computed. Determinations are also made by the students for latitude, time and azimuth, and various other special problems are worked out practically. For this work the class goes to a suitable point, at a distance from the city, the third Monday before the beginning of the college year. A map of this survey is drawn after return from the field.

To *higher surveying*, three hours a week are given. This includes hydrographic, mining, city and geodetic surveying, with the mathematical principles involved and the practical methods of operation used in the field; earth-work computations, etc.

The following is a description of the equipment for Surveying:—Transits for ordinary field work, one altazimuth instrument for triangulation and astronomical work, reading to ten seconds of arc on both horizontal and vertical circles, two engineer's levels, two needle compasses, one sextant, one plane table, one 300-foot steel tape standardized, and all the necessary accompanying apparatus for field and office work, such as stadia rods, level rods, stadia slide-rules, chains, tapes, signals, protractors, parallel rules, etc. There is also a complete mining transit, adapted to the use of the stadia, which may be used for topographical work if required.

7. *Mechanical Engineering, Washington.*—The course in Mechanical Engineering for the first two years is identical with the Civil Engineering Course, and changes only in the two final years. It is developed as follows:—

PROGRAMME IN MECHANICAL ENGINEERING, WASHINGTON UNIVERSITY.

FRESHMAN YEAR.

(The same as for Civil Engineering).

SOPHOMORE YEAR.

(The same as for Civil Engineering).

JUNIOR YEAR.

First Term.	Hrs. per Week.
Mechanical Engineering—	
Kinematics of Machinery	3
Machine Designing	3
Machinery Drawing	3
Mechanical Laboratory	3
Electrical Engineering: Electrical Machinery	3
Mathematics: Integral Calculus	3
Mechanics: Statics, Distribution of Stress...	(?)
Physics: Electrical Measurements	6

Second Term.	Hrs. per Week.
Mechanical Engineering—	
Machine Designing and Mill Engineering	3
Elementary Steam Engineering ...	3
Machinery Drawing	3
Mechanical Laboratory...	3
Civil Engineering—	
Testing Laboratory Practice	3
Contracts and Specifications	1
Electrical Engineering—	
Electrical Machinery	3
Laboratory Practice	3
Mechanics: Action of Unbalanced Forces...	(?)
Physics: Electrical Measurements	6

SENIOR YEAR.

First Term.	Hrs. per Week.
Mechanical Engineering—	
Advanced Steam Engineering	3
Steam Engine Designing	3
Engine Designing	6
Mechanical Laboratory...	6
Civil Engineering—Hydraulics	3
Electrical Engineering—Transmission ...	2
Mechanics—Deflection and Torsion ...	—

Second Term.	Hrs. per Week.
Mechanical Engineering—	
Boiler and Chimney Designing ...	3
Heating and Ventilation	3
Pumps, Cooling Towers, Air Compressors, etc.	3
Boiler Designing	3
Laboratory practice	6
Thesis	—
Mechanics—Kinematics and Mechanisms ...	—

The laboratory has a plain slide-valve engine, fitted up with a Prony brake; three separate valves, a gas-engine, steam calorimeter, Crosby indicators, a Thomson coal calorimeter, pyrometer, lubricator testing apparatus, standard gas-meter. It has, since the Commissioners' visit, been fitted up with a much larger amount of apparatus.

8. *Electrical Engineering Washington.*—The course in electrical engineering is as follows:—

PROGRAMME IN ELECTRICAL ENGINEERING, WASHINGTON UNIVERSITY.

FRESHMAN YEAR.

First Term.	Hrs. per Week.
Mathematics—	
Higher Algebra	3
Plane Trigonometry	2
French, or German } Elementary Course	—
Shop—Woodwork	—
English—Composition	—
General Course in Chemistry—	
Two Lectures, 2 hours... ... } Laboratory practice, 2 hours ... }	4
Freehand Drawing	6
Drawing—Lettering and Instrumental ...	3

Second Term.	Hrs. per Week.
Spherical Trigonometry	1
Analytical Geometry	3
Elementary French, or ,, German ... ... }	—
Shop—Pattern work and Moulding ...	—
English—Forms of Prose	—
Descriptive Chemistry—	
Two Lectures, 2 hours... ... } Laboratory practice, 2 hours ... }	4
Physics: Elementary Mechanics—	
Two Lectures or Recitations, 2 hours } Laboratory practice, 2 hours ... }	4
Drawing—Geometrical and Lettering ...	4

SOPHOMORE YEAR.

First Term.	Hrs. per Week.
French, or German } Reading and Composition ...	3
Mathematics: Analytical Geometry ...	3
Physics: Heat and Light—	
Three Lectures or Recitations, 3 hours } Laboratory practice, 3 hours ... }	6
Mathematics: Descriptive Geometry—	
Two Lectures, 2 hours... ... } Drawing, 2 hours ... ... }	4
Chemistry—Qualitative Analysis	6
Drawing—Mechanical and Lettering ...	6
Shop—Forge and Machine-work	—

Second Term.	Hrs. per Week.
Physics—Electricity and Magnetism—	
Three Lectures or Recitations, 3 hours } Laboratory practice, 3 hours ... }	6
Civil Engineering: Surveying—	
Two Recitations, 2 hours ... } Field practice, 6 hours ... }	8
Mathematics—Differential Calculus ...	3
Mechanics—Statics	—
Shop—Machine-work	—
Mathematics: Descriptive Geometry—	
Two Lectures, 2 hours ... } Drawing, 2 hours ... ... }	4

In addition to the shopwork above referred to electrical engineering students take six days of six hours each in shopwork during commencement week and the week following.

JUNIOR YEAR.

First Term	Hrs. per Week.
Electrical Engineering—Study of Electrical machinery	3
Mechanical Engineering—	
Kinematics	3
Machine Designing	3
Drawing...	3
Mathematics—Integral Calculus	3
Mechanics—Statics, Distribution of Stress...	—
Physics—Electrical Measurements	6
Mechanical Engineering—Laboratory ...	3

Second Term.	Hrs. per Week.
Electrical Engineering—	
Alternating currents	3
Laboratory work	3
Mechanical Engineering—	
Machine Designing and Mill Engineering	3
Steam Engine	3
Drawing	3
Civil Engineering—	
Testing laboratory	3
Specifications and Contracts	1
Mechanics—Unbalanced Forces	—
Physics—Electrical Measurements	6
Mechanical Engineering—Laboratory ...	3

SENIOR

SENIOR YEAR.

First Term.	Hrs. per Week.
Electrical Engineering—	
Current Machinery	3
Drawing-room work	6
Laboratory work	6
Electrical testing, etc.	2
Civil Engineering—Hydraulics	3
Mechanics—Deflections and Torsion ...	—
Physics—Mathematical Theory of Electricity and Magnetism	3

Second Term.	Hrs. per Week.
Electrical Engineering—	
Alternating Current Machinery ...	3
Drawing-room work	6
Laboratory work	9
Street-railway working, etc.	2
Treatment of some Engineering Project	2
Mechanics—Kinematics and Mechanism Thesis	—

The laboratory equipment consists of the following instruments and machines, viz.:—Two Kelvin current balances, Sieman's dynamometer, Thomson's Quadrant electrometer, a number of Western and Thomson portable ammeters, voltmeters, and wattmeters, two Wheatstone bridges, a Leed's potentiometer, Elliot and Stanley Condensers, auxiliary galvanometers, standard ammeters, voltmeters, and wattmeters, with shunts and multipliers, Cahart—Clerk standard cells, standard resistances (Charlottenburg Reichanstalt) tachometers, etc.

The machines are the following:—High speed Buckeye engine, 20 h.-p.; a Wagner single phase induction-motor, 5 h.-p.; small Wood shunt-wound generator; a Wood series-wound cradle mounted generator; a small multi-polar motor; a 15 h.-p. bipolar motor; 15 kilowatt multi-polar motor; 10 kilowatt three-phase alternator; a 10 kilowatt rotary converter; a three-phase induction motor, 5 h.-p.; 5 kilowatt auto-transformer.

9. *Chemical Engineering, Washington University.*—Chemical Engineering is a subject that has commanded considerable attention in recent years, and necessarily so, inasmuch as chemical technology has become intimately associated with engineering, and there is reason to believe that in the near future chemical engineering will be a well defined profession. The equipment for this department calls for no special comment.

The Programme of the Course in Chemical Engineering is as follows:—

PROGRAMME IN CHEMICAL ENGINEERING, WASHINGTON UNIVERSITY.

The *Freshman Year* is the same as for Mechanical Engineering, so also is the *First Term* of the *Sophomore Year*.

SOPHOMORE YEAR.

Second Term.	Hours per Week.
Chemistry: Quantitative Analysis	6
Civil Engineering: Surveying—	
Two recitations, 2 hours ... ... } Field practice, 6 hours ... ... }	8
Mathematics—	
Differential Calculus	3
Descriptive Geometry—	
Two lectures, 2 hours ... ... } Drawing, 2 hours ... ... }	4
Mechanics: Statics—	
Physics: Electricity and Magnetism—	
Three lectures or recitations, 3 hours ... } Labatory practice, 3 hours ... ... }	6

JUNIOR YEAR.

First Term.	Hrs. per Week.
Organic Chemistry	3
,, ,, Laboratory work ...	6[1]
Chemistry—Mineralogy	3
Mechanical Engineering—Machine Designing	3
Electrical Engineering—Electric Machinery	3
Mathematics—Integral Calculus	3
Mechanics—Statics and Distribution of Stress	—

Second Term.	Hrs. per Week.
Organic Chemistry	3
,, ,, Laboratory work ...	6
Chemistry—Descriptive Mineralogy ...	3
Mechanical Engineering—Machine Designing and Mill Engineering	3
Mechanics—Action of Unbalanced Forces ...	—
Mechanical Engineering—Steam Engine ...	3
General Course in Geology	3

SENIOR YEAR.

First Term.	Hrs. per Week.
Chemistry—	
Advanced Quantitative Analysis ...	6[1]
Laboratory work	1
Industrial and Engineering (Lectures and Laboratory work)	2
Research work, etc.	—
Civil Engineering—Hydraulics	3
Electrical Engineering—Direct Current Motors, etc.	3
Mechanics—Deflections and Torsion ...	—
Botany—Bacteriology (Laboratory work) ...	1

Second Term.	Hrs. per Week.
Chemistry—	
Advanced Quantitative Analysis ...	6[1]
Chemical Seminary Discussions ...	1
Industrial and Engineering (Lectures and Laboratory)	2
Research work, etc.	—
Civil Engineering—(Engineering Materials)	3
Electrical Engineering—Design of Direct Current Machinery	3
Mechanics—Kinematics and Mechanism ...	—
Botany—Bacteriology (Laboratory work) ...	1

The

[1]Or twelve hours a week.

The Chemical Laboratory is provided with the necessary glass and other apparatus, a collection of organic specimens, and a reference library.

10. *Course in "Science and Literature," Washington University.*—In the "Science and Literature" Course the *Freshman* and *Sophomore Years* are identical with those of Civil Engineering. The work of the remaining two years is as hereunder:—

Junior Year.—The work of the Junior Year consists of nine courses of instruction, all elective, but the choice of studies must be approved by the Dean at the beginning of each term.

Senior Year.—The work of the Senior Year consists of nine courses of instruction, all elective, and approved as in the Junior Year. A *Thesis* of literary or scientific character acceptable to the Faculty is required as one condition of graduation.

11. *Course in Architecture, Washington University.*—The work for the Freshman and Sophomore Years is substantially the same as that for Civil Engineering.

The two last years in Architecture include the study of Advanced Free-hand drawing, water-colour drawing, history of ancient architecture, history of mediæval architecture, history of renaissance and modern architecture, the elements of architecture, elementary architectural drawing, sketch design, advanced design, building construction, history of sculpture and painting, and the preparation of a thesis.

The degree of *Batchelor of Science* is conferred on the satisfactory completion of the four years' work.

The professional degrees of Civil Engineer, Mechanical Engineer, Electrical Engineer, Chemical Engineer, and Architect are conferred only after three or more years of actual and successful practice, one year of which must have been spent in responsible charge of engineering architectural work, and the presentation of an acceptable thesis.

12. *Polytechnic Institutes of the United States.*—There are, in the United States, a number of establishments for higher technical education known as "Polytechnic Institutes." They are really technical Universities. A complete account of these is quite out of the question, but the courses in four of them will be taken as illustrative. These are the Brooklyn, Worcester, Rose, and Rensselaer Polytechnic Institutes. Their origin is indicated hereunder:—

Institute.	Founded.	Degrees Conferred.[1]
Brooklyn	1854	B.A.; B.Sc.; C.E.; E.E.; M.E.; M.A.; M.Sc.
Worcester	1865	B.Sc.; M.Sc.; D.Sc.; C.E.; M.E.; E.E.
Rose	1874	B.Sc.; M.Sc.; C.E.: M.E.; E.E. C.E.;
Rensselaer...	1824	B.Sc.

The constitution of these is clearly not identical, and an outline will be given of the character of each.

13. *Polytechnic Institute of Brooklyn.*—The Polytechnic Institute of Brooklyn is a school of science and liberal arts, offering broad opportunities for collegiate instruction. It was established in 1854, and granted its first degrees in Arts and Sciences in 1871, by special authority of the Regents of the State University. It was reorganised in 1890, and now confers those of Bachelor of Arts, Bachelor of Science, Civil Engineer, Electrical Engineer, Mechanical Engineer, Master of Arts and Master of Science. In all of its courses, its aim is to "impart a liberal education, and to develope the intellectual faculties of the student, while it recognises the fact that the great essential of all education is the formation of good habits, and of a character in which shall be found the virtues that contribute to high citizenship."

Candidates are admitted (*a*) by examination, (*b*) by certificate. The subjects of the examination are divided into two groups—prescribed and elective. For all courses but the course in Arts the subjects that must be presented are:—English, Elementary and Advanced Algebra, History, Plane and Solid Geometry, and Modern Languages.

The candidates for the course in Arts must present Elementary Algebra, English, History, Modern Languages and Plane Geometry.

The following are the *elective* groups for the scientific courses:—Physics, Botany, Physiology and Hygiene, Elementary Latin, Chemistry, Zoology, Physiography, Elementary Greek and Modern Languages.

And for the course in Arts they are Physics, Botany, Chemistry, Zoology, Physiography, Elementary Greek, Elementary Latin, Advanced Algebra, Solid Geometry, Physiology and Hygiene and Modern Languages.

(*b*) *Certificate.*—Certificates of proficiency are accepted in lieu of examination from students of the Polytechnic Preparatory School, the Public High Schools of Brooklyn and Manhattan and other accredited institutions. This is conditioned upon students proving themselves able to do the full work of their class.

Students are allowed to attend lectures and recitations in particular departments only upon giving evidence of their thorough preparation.

The regular curriculum provides five *undergraduate courses* of four years' duration each, viz., Arts, Chemistry, Civil Engineering, Electrical Engineering, Mechanical Engineering. The graduate courses are those leading to the Master of Arts and Master of Science.

14.

[1] B.A. and M.A. are Bachelor and Master of Arts; B.Sc., M.Sc., and D.Sc. are Bachelor, Master, and Doctor of cience C.E, E.E., and M.E., denote respectively Civil Engineer, Electrical Engineer, and Mechanical Engineer.

14. *Arts course in the Brooklyn Polytechnic.*—In order to fully compare the Polytechnic courses with those of a University, and also in order to reach any definite idea of the relative grade of the teaching, it is necessary to compare the Arts courses as well as the others of a technical character. The following brief outline will serve the purpose indicated.

Programme of the Arts course, Brooklyn Polytechic.

FRESHMAN YEAR.

First Semester.

Subjects.	Hrs. per Week.
English Composition	3
Debates	1
Nineteenth Century French, *or*	3
Classical French	3
Introductory German, *or*	2
Modern German Prose	2
Solid Geometery	2
Trigonometry	3
Higher Algebra	2
General Chemistry	3

Second Semester.

Subjects.	Hrs. per Week.
English Composition	3
Debates	½
Nineteenth Century French, *or*	2
Classical French	2
Introductory German, *or*	3
Modern German Prose	3
Mediæval History	3
General Chemistry	3

SOPHOMORE YEAR.

Advanced Composition	1
Debates	½
History of English Language	2
Shakespeare, Spenser and Milton	3
History of Modern Europe	3
Classical French, *or*	3
Outlines French Literature	2
Modern German Prose, *or*	2
Outlines, German Literature	3
Zoology	1
Geology	1

Advanced Composition	½
Debates	½
English Literary Epochs	3
Shakespeare, Spenser and Milton	3
History of Renaissance, *or*	3
History of France	3
Classical French, *or*	2
Outlines, French Literature	3
Modern German Prose, *or*	3
Outlines of German Literature	2
Geology	2

JUNIOR YEAR.

Prescribed Studies.

First Semester.

Subjects.	Hrs. per Week.
Argumentative Composition	1
General Oratory	½
English Novel, *or*	3
Eighteenth Century Literature	3
English History (a study of social and political conditions in England from the Saxon period to the death of Elizabeth) *or*	2
English History (a study of social and political conditions in England from the death of Elizabeth to the present)	2
American Political History	2
Electricity and Magnetism	3

Second Semester.

Subjects.	Hrs. per Week.
Nineteenth Century Poetry	3
General Oratory	½
Logic	2
American Political History	2
Sound, Heat, Light	—

Elective Studies.[1]

Science of Language	3
History of Art	2
Outlines, French Literature	2
Mediæval French	2
Early French, *or*	2
Outlines, German Literature	3
Elementary Spanish	3
Laboratory Physics	2
General Astronomy	3
Advanced Free-hand Drawing	2

History of Education	2
History of Art	2
Architecture	3
Outlines of French Literature	3
Mediæval French	2
Early German, *or*	2
Outlines, German Literature	2
Elementary Spanish	3
Laboratory Physics	2
Finance	3
Sociology	3
Advanced Free-hand Drawing	2

SENIOR

[1] All prescribed studies are required to be taken, and of the elective studies it is required that enough be taken to bring the total number of hours for both semesters to sixteen per week. Junior electives not taken in the Junior year may be taken in the Senior year.

SENIOR YEAR.

Prescribed Studies.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects	Hrs. per Week.
General Oratory	½	General Oratory	½
Comparative Study of Literary Types	3	Comparative Study of Literary Types	3
Psychology	3	Ethics	3
History of Philosophy	3	Mediæval French, *or*	2
Mediæval French, *or*	2	Early German, *or*	2
Early German, *or*	2	Spanish Literature, *or*	2
Spanish Literature, *or*	2	Elementary Italian	2
Elementary Italian	2		

Elective Studies.

Literary Forms	1	English Romantic Movement	3
American Literature	3	Literary Criticism	3
Chaucer	3	United States History	3
Anglo-Saxon	2	History of Philosophy	3
Comparative Constitutional Law	3	Aesthetics	2
Advanced Free-hand Drawing	2	International Law	3
Science of Language	3	Advanced Free-hand Drawing	2
History of Art	2	Advanced Oratory	1
General Astronomy	3	Architecture	3
		History of Art	2
		Finance	3
		Sociology	—

15. *Course in Chemistry, Brooklyn Polytechnic.*—This course, leading to the degree of Bachelor of Science, is designed "for students who intend to become *analytical or manufacturing chemists,* and it is well adapted also to the needs of those preparing to become teachers in this science." Those completing the course are equipped "to undertake professional responsibility immediately upon graduation. The programme is as follows :—

PROGRAMME OF THE COURSE IN CHEMISTRY, BROOKLYN POLYTECHNIQUE.

FRESHMAN YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
English Composition	3	English Composition	3
Debates	1	Debates	½
Scientific French, *or*	2	Scientific French, *or*	3
Classical French, *or*	3	Classical French, *or*	2
Scientific German, *or*	3	Scientific German, *or*	2
Modern German Prose	2	Modern German	3
Trigonometry	3	Analytical Geometry	5
Higher Algebra	2	General Chemistry	6
General Chemistry	6	Object Drawing	5
Mechanical Drawing	5		

SOPHOMORE YEAR.

First Semester.	Hrs. per Week.	*Second Semester.*	Hrs. per Week.
Advanced Composition	1	Advanced Composition	½
Debates	½	Debates	½
History, English Language	2	English Literary Epochs	3
Mechanics	2	Mechanics	2
Classical French, *or*	3	Classical French, *or*	2
Modern German Prose	2	Modern German Prose	3
Blow-pipe Analysis	6	Descriptive Geometry	3
Qualitative Analysis	12	Qualitative Analysis	18

JUNIOR YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
General Oratory	½	General Oratory	½
Electricity and Magnetism	3	Sound, Heat, Light	3
Laboratory Physics	2	Laboratory Physics	2
Descriptive Mineralogy	4	Determinative Mineralogy	4
Metallurgy	5	Industrial Chemistry	2
Quantitative Analysis	12	Quantitative Analysis	18

SENIOR

SENIOR YEAR

First Semester.	Hrs. per Week.	Second Semester.	Hrs. per Week.
General Oratory	½	General Oratory	½
Theoretical Chemistry	2	Organic Chemistry	21
Organic Chemistry	15	Thesis	15
Thesis	15		

OPTIONAL STUDIES FOR SPECIALIZATION.

First Semester.	Hrs. per Week.	Second Semester.	Hrs. per Week.
Oil and Gas Analysis	6	Water Analysis	6
Medical Chemistry	6	Chemistry of Fabrics	6
Advanced Inorganic Chemistry	2	Assaying of Gold and Silver	6
Electrolysis and Electrosynthesis of Organic Compounds	6	Determination of Molecular Weights	6

16. *Course in Civil Engineering, Brooklyn Polytechnic.*—This course leading to the degree of Civil Engineer, aims at equipping the student with the theoretical and practical training requisite for successful independent work. The instruction demands a considerable amount of practice in the field and the drafting-room, and "a thorough mastery of all the instruments required for use in the profession."

The view taken of the requirements of the course is thus expressed :—"Upon completing the course in Civil Engineering, the student, in addition to his theoretical knowledge, should possess a thorough mastery of all the instruments which he will be called upon to use in his profession, and at the same time should have acquired the elements of a liberal education, sanity of judgment, and the ability successfully to undertake and control engineering enterprises of magnitude."

The details of the course are as follows :—

PROGRAMME OF THE COURSE IN CIVIL ENGINEERING, BROOKLYN POLYTECHNIC.

FRESHMAN YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
English Composition	3	English Composition	3
Debates	1	Debates	½
Scientific French, or	2	Scientific French, or	3
Classical French, or	3	Classical French, or	2
Scientific German, or	3	Scientific German, or	2
Modern German Prose	2	Modern German Prose	3
Trigonometry	3	Analytical Geometry	5
Higher Algebra	2	General Chemistry	6
General Chemistry	6	Mechanics	2
Mechanical Drawing	4	Shopwork : Carpentry and Foundry-work	3
Mechanics	2		
Shopwork : Carpentry	3		

SOPHOMORE YEAR.

First Semester.	Hrs. per Week.	*Second Semester.*	Hrs. per Week.
Advanced Composition	1	Advanced Composition	½
Debates	1½	Debates	½
History, English Language	2	English Literary Epochs	3
Differential Calculus	3	Descriptive Geometry	3
Qualitative Analysis	5	Integral Calculus	3
Electricity and Magnetism	3	Sound, Heat, Light	3
Laboratory Physics	2	Drafting	3
Zoology	1	Laboratory Physics	2
Geology	1	General Field Work	9
Elementary Surveying	3	Geology	2
Levelling	3	Shopwork : Chipping and Filing	3
Shopwork : Forging	3		

JUNIOR YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
General Oratory	½	General Oratory	½
Analytical and Applied Mechanics	5	Analytical and Applied Mechanics	2
Topographical Drawing	2	Architecture	3
Mechanics of Materials	3	Mechanics of Materials	3
Thermodynamics	3	Heat and other Motors	3
Heat and other Motors	2	Hydromechanics	3
Mechanical Laboratory	3	Hydraulic Laboratory	3
Railway Survey	3	Hydrographic Survey	5
General Astronomy	3	Spherical and Practical Astronomy	3
Shopwork : Machine-work	3	Shopwork : Tool-making	3

SENIOR

SENIOR YEAR.

First Semester.	Hrs. per Week.	*Second Semester.*	Hrs. per Week.
General Oratory	½	General Oratory	½
Differential Equations	2	Foundations	2
Least Squares	1	Arches and Dams	3
Law of Contracts	1	Framed Structures	5
Framed Structures	4	Design and Specifications	2
Street and Road Engineering	2	Thesis	15
Water Supply and Irrigation	2		
Drainage Survey	3		
Design and Specifications	2		
Thesis	10		

17. *Course in Electrical Engineering, Brooklyn Polytechnic.*—This course, leading to the degree of Electrical Engineer, is intended to meet "the needs of those students who desire to enter professionally upon the various applications of electricity to the useful arts. Special preparation is afforded those who in *after life* may be concerned with electric railways, with the telephone, with electro-metallurgy, with electric lighting, generation, transmission, and the utilization of electric power."

The following is a detailed account of the course :—

PROGRAMME OF THE COURSE IN ELECTRICAL ENGINEERING, BROOKLYN POLYTECHNIC.

FRESHMAN YEAR.

(Same as for Civil Engineering).

SOPHOMORE YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
Advanced Composition	1	Advanced Composition	½
Debates	½	Debates	½
History, English Language	2	English Literary Epochs	3
Differential Calculus	3	Descriptive Geometry	3
Qualitative Analysis	5	Integral Calculus	3
Electricity and Magnetism	3	Sound, Heat, Light	3
Machine Drawing	5	Electrical Measurements	6
Laboratory Physics	2	Principles of Mechanism	5
Shopwork : Forging	3	Laboratory Physics	2
		Shopwork : Chipping ; filing	3

JUNIOR YEAR.

First Semester.	Hrs. per Week.	*Second Semester.*	Hrs. per Week.
General Oratory	½	General Oratory	½
Analytical and Applied Mechanics	5	Analytical and Applied Mechanics	2
Quantitative Analysis	2	Dynamo Electricity	3
Mechanics of Materials	3	Dynamo Laboratory	6
Testing Materials	3	Hydromechanics	3
Mechanical Laboratory	3	Hydraulic Laboratory	3
Thermodynamics	3	Elementary Machine Design	5
Heat and other Motors	2	Heat and other Motors	3
Shopwork : Machine-work	3	Shopwork : Tool-making	3

SENIOR YEAR.

First Semester. Subjects.	Hrs. per Week.	*Second Semester.* Subjects.	Hrs. per Week.
General Oratory	½	General Oratory	½
Differential Equations	2	Telephone	2
Law of Contracts	1	Electric Railway	1
Framed Structures	4	Long Distance Transmission of Power	1
Power Generation and Distribution	3	Electrical Design	2
Metallurgy of Iron and Copper	2	Electric Lighting	3
Alternating Currents	3	Thesis	15
Alternating Current Laboratory	9		
Electrical Design	2		
Thesis	10		

18. *Course in Mechanical Engineering, Brooklyn Polytechnic.*—This course, leading to the degree of Mechanical Engineer, is designed to give students a "thorough training in the principles of pure and applied science, and a technical skill that will fit them to cope with problems of manufacture and trade in the undertaking of industrial enterprises."

"Throughout

"Throughout the course the reasoning faculties are developed, the hand trained to deftness in execution, the judgment of proportion in design is cultivated. . . . . Upon graduation the student should be competent to assume at once professional responsibility in the design, erection, and operation of ordinary types of machinery." The details of the course are as follows:—

PROGRAMME OF THE COURSE IN MECHANICAL ENGINEERING, BROOKLYN POLYTECHNIC.

FRESHMAN YEAR.

First Semester.

Subjects.	Hrs. per Week.
English Composition	3
Debates	1
Scientific French, *or*	2
Classical French, *or*	3
Scientific German, *or*...	3
Modern German Prose	2
Trigonometry...	3
Higher Algebra	2
General Chemistry	6
Mechanics	2
Free-hand Drawing	3
Mechanical Drawing	4
Shopwork : Carpentry	6

Second Semester.

Subjects.	Hrs. per Week.
English Composition	3
Debates	$\frac{1}{2}$
Scientific French, *or*	3
Classical French, *or*	2
Scientific German, *or*...	2
Modern German Prose	3
Analytical Geometry	5
General Chemistry	6
Mechanics	2
Free-hand Drawing	3
Shopwork : Carpentry and Foundry-work ...	6

SOPHOMORE YEAR.

First Semester.

Subjects.	Hrs. per Week.
Advanced Composition	1
Debates	$\frac{1}{2}$
History of English Language	2
Differential Calculus	3
Qualitative Analysis...	5
Electricity and Magnetism	3
Machine Drawing	5
Laboratory Physics	2
Shopwerk : Forging	6

Second Semester.

Subjects.	Hrs. per Week.
Advanced Composition	$\frac{1}{2}$
Debates	$\frac{1}{2}$
English Literary Epochs	3
Descriptive Geometry	3
Integral Calculus	3
Sound, Heat, Light	3
Principles of Mechanism	5
Laboratory Physics	2
Shopwork : Chipping and Filling	6

JUNIOR YEAR.

First Semester.

Subjects.	Hrs. per Week.
General Oratory	$\frac{1}{2}$
Analytical and Applied Mechanics... ...	5
Metallurgy of Iron and Copper	2
Mechanics of Materials	3
Testing Materials	3
Thermodynamics	3
Mechanical Laboratory	3
Engineering Drawing	2
Heat and other Motors	2
Shopwork : Machine-work	6

Second Semester.

Subjects.	Hrs. per Week.
General Oratory	$\frac{1}{2}$
Analytical and Applied Mechanics... ...	2
Dynamo Electricity	3
Dynamo Laboratory	1
Hydro-mechanics	3
Hydraulic Laboratory	3
Flue Gas Analysis	2
Boilers and Injectors	2
Elementary Machine Design	5
Heat and other Motors	3
Shopwork : Tool-making	6

SENIOR YEAR.

First Semester.

Subjects.	Hrs. per Week.
General Oratory	$\frac{1}{2}$
Psychology, *or*	3
Political Economy	3
Differential Equations	2
Law of Contracts	1
Framed Structures	4
Heating and Ventilating of Buildings ...	2
Chimney Construction and Design	1
Pumps and Pumping Machinery	2
Mechanical Laboratoy, Pumps	3
Power Generation and Distribution ...	3
Advanced Machine Design	8
Thesis...	5

Second Semester.

Subjects.	Hrs. per Week.
General Oratory	$\frac{1}{2}$
Foundations	2
Architecture	3
Mill Design and Administration	2
Prime Motors	3
Advanced Machine Design	5
Thesis...	15

19. *General regarding the Brooklyn Polytechnic.*—Besides the above courses, there is, as stated, a *Graduate Course in Arts*, leading to the degree of Master of Arts; and a *Graduate Course in Science*, in the departments of chemistry, civil, electrical, and mechanical engineering, leading to the degree of Master of Science, each of one year's duration.

The Institute is under the administration of a President, Faculty—which consists of the President and the professors—and a Dean.

Associated with the Polytechnic are a library, studio, observatory, and collections, laboratories, viz., chemical, physical, electrical, dynamo, engineering, hydraulic and steam; a telephone equipment; shops, viz., carpentry and pattern shop, the forge-shop and machine-shop; and there is also a gymnasium. A chemical and an engineering society are affiliated with the Polytechnic. The

The tuition fee for students entered upon any course leading to a degree is two hundred dollars per annum (say, £40). The fee for special students upon selected or special courses is at the rate of fifteen dollars per annum (say, £3) for each hour of lecture or recitation attendance a week, the minimum charge, however, being fifty dollars (say, £10), and the maximum two hundred dollars, as above.

The tuition fee covers all apparatus, materials, and tools required for use in the machine-shops, and the physical and mechanical laboratories, as well as all privileges of the gymnasium and baths, full use of the library, and the ordinary charges for matriculation and graduation.

20. *The Worcester Polytechnic Institute.*—This Institute, founded by John Boynton, of Templeton, in 1865, offers courses of study designed to meet "the wants of those who wish to become mechanical, civil, or electrical engineers or chemists, and is incidentally well suited to those who desire to become teachers of mathematics, the physical sciences, designing, etc." Its underlying principle is that its courses of study and its laboratory exercises are so arranged as to furnish such intellectual discipline and training as is of real value in so-called "liberal education," and at the same time equip with a good knowledge of the sciences, especially those relating to the profession selected. A considerable amount of actual professional practice is also provided in the course.

Several large and well arranged and equipped buildings are devoted to laboratory methods. In the workshop training mere manual skill is "subordinated to the higher accomplishments of the engineer," and is "arranged and conducted as nearly as may be in accord with the best modern standards." This institute was one of the first institutions in America to establish workshops as an adjunct to the training of the mechanical engineer.

The conditions of admission are that the candidate be not less than 16 years of age, and that he pass an examination in the following subjects, which are divided into two groups, viz.:—

Group I.

Preliminary Subjects:
1. United States History.
2. English Grammar, including Composition.

Group II.

Advanced Subjects...:
1. Algebra.
2. Plane Geometry.
3. Solid Geometry.
4. English.
5. French or German.

The instruction is given by lectures, recitations, and laboratory and workshop practice. The classes are divided into small sections, and sufficient time is allotted to each exercise to secure the utmost thoroughness. The laboratory or workshop practice occupies at least eight hours weekly in each course.

There are five courses of study, viz., I. Mechanical Engineering; II. Civil Engineering; III. Chemistry; IV. General Science; and V. Electrical Engineering; each of four years' duration. Graduate courses of one year each are provided for in the first three and last-mentioned subjects to which the graduates of the same are admitted.

21. *Course in Mechanical Engineering, Worcester Polytechnic.*—This course aims at imparting to students the knowledge of scientific principles, forming the foundation of all engineering, but with special regard to those principles relating to the design, construction, and operation of machinery. It is developed as follows:—

PROGRAMME IN MECHANICAL ENGINEERING, WORCESTER POLYTECHNIC.

FRESHMAN YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Freehand Drawing ...	3	Freehand Drawing ...	3
English (Advanced Rhetoric)	2	Elementary French; *or*	5
Advanced French; *or*	3	Elementary German ...	5
Advanced German ...	3	Trigonometry ...	3
Algebra ...	2	Inventional Geometry	2
Shop Practice—Wood Work	8	Shop Practice (Wood Work)	12[1]
Inorganic Chemistry—		Inorganic Chemistry—	
Two lectures ...	2	Two lectures ...	2
One recitation ...	1	One recitation ...	1
Laboratory practice	2	Laboratory practice	2

SOPHOMORE YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Mechanical Drawing ...	4	Mechanical Drawing ...	4
Descriptive Geometry—Elements of Projection Drawing (two recitations a week)	2	Descriptive Geometry—Elements of Projection Drawing—One lecture ...	1
Advanced French ...	4	Advance French ...	4
Advanced German ...	4	Advance German ...	4
Analytic Geometry. Plane...	5	Differential and Integral Calculus ...	6
General Physics—		General Physics—	
Three lectures ...	3	Three lectures ...	3
Two recitations ...	2	Two recitations ...	2
Shop Practice—Machine Work	4[2]	Shop Practice—Machine Work	12[3]
Mechanical Engineering—The Operation of Engines and Boilers ...	10[4]	Mechanical Engineering—The Operation of Engines and Boilers ...	10[4]

JUNIOR

[1] Thirteen weeks, twelve hours a week and 168 hours Summer Practice. [2] Ten weeks, twelve hours a week. [3] Twelve weeks, twelve hours a week and 168 hours Summer Practice. [4] Ten hours a term.

JUNIOR YEAR.

First Term.	Hrs. per Week.
English (English Literature)	2
Elements of Economics—	
One lecture...	1
Two recitations	2
Applied Mechanics—Statics and Dynamics, Dynamics of Rectilinear motion ...	4
Laboratory Course in Physics—	
One lecture...	1
Laboratory practice	4
Shop Practice—	
Foundry work	8[1]
Machine work	8[2]
Mechanical Engineering—The Operations of Engines and Boilers	20[3]
Mechanical Engineering—Elementary Steam Engineering (two recitations)	2
Mechanical Engineering—Kinematics of Machinery (Drawing)	4[4]
Electrical Engineering—The Elements of Electrical Engineering (two lectures) ...	2

Second Term.	Hrs. per Week.
Political Science—The American Political System—	
Two lectures	2
Two recitations	2
Applied Mechanics—Dynamics, Strength of Materials	4
Laboratory Course in Physics—	
One lecture	1
Laboratory practice	4
Shop Practice—	
Machine Work	8[5]
Forge Work	8[6]
Mechanical Engineering—The Operation of Engines and Boilers	20[7]
Mechanical Engineering—Kinematics of Machinery	4[8]
Electrical Engineering—The Elements of Electrical Engineering (two lectures)	2
Mineralogy—	
One lecture	1
Laboratory practice	1
Metallurgy—One lecture	1

SENIOR YEAR.

First Term.	Hrs. per Week.
English—Argumentation	2
Applied Mechanics—Strength of Materials. Dynamics of Rigid Bodies	2
Shop Practice—	
Machine Work	4[9]
Wood Work	4[10]
Mechanical Engineering—Thermodynamics	3
" " Laboratory Practice	49[11]
" " Theoretical Hydraulics	2
" " Laboratory Practice ...	28[12]
" " " "	21[13]
" " Machine Parts (designing)	6[14]
Electrical Engineering Laboratory—Laboratory Practice	5
Chemistry—Gas Analysis	2

Second Term.	Hrs. per Week.
Applied Mechanics—Dynamics of Rigid Bodies, Dynamics of Machinery ...	2
Shop Practice—	
Wood Work	4[15]
Forge Work	4[16]
Mechanical Engineering—Advanced Steam Engineering (three recitations) ...	3[17]
Mechanical Engineering—Laboratory Practice	56[18]
" " Applied Hydraulics	2
" " Laboratory Practice	21[19]
" " " " ...	35
" " Machine parts (designing)	6[20]
" " Thesis	12
Electrical Engineering Laboratory (Laboratory Practice)	5

22. *Civil Engineering, Worcester Polytechnic.*—The details of the Course in Civil Engineering, which is designed to prepare the student in the *art* of engineering, also to furnish him with a grasp of the fundamental principles of the *science* of engineering, are as follows:—

FRESHMAN YEAR.

First Term.	Hrs. per Week.
Freehand Drawing	3
English—Advanced Rhetoric	2
Advanced French; *or*	3
Advanced German	3
Algebra	2
Shop Practice—Woodwork	8[21]
Inorganic Chemistry—	
Two lectures, 2 hrs. / One recitation, 1 hr. / Laboratory practice, 2 hrs.	5

Second Term.	Hrs. per Week.
Freehand Drawing	3
Elementary French; *or*	5
Elementary German	5
Trigonometery	3
Inventional Geometry	2
Shop Practice—	
Forge Work	4[22]
Machine Work	4[23]
Civil Engineering—Surveying	10[24]
Inorganic Chemistry—	
Two lectures, 2 hrs. / One recitation, 1 hr. / Laboratory practice, 2 hrs.	5

SOPHOMORE

[1] For four weeks. [2] For eleven weeks. [3] Twenty hours a *term.* [4] Or one lecture and one recitation a week. [5] For twelve weeks and 168 hours Summer Practice. [6] For six weeks. [7] Twenty hours a *term.* [8] Four hours drawing, or one lecture and one recitation a week. [9] For Eleven weeks. [10] For Four weeks. [11] Forty-nine hours a *term.* [12] Twenty-eight hours a *term.* [13] Twenty-one hours a *term.* [14] Or two recitations or lectures a week. [15] For Eleven weeks. [16] For six weeks. [17] Or draughting-room equivalent. [18] Fifty-six hours a *term.* [19] Twenty-one hours a *term.* [20] Or two lectures or recitations a week. [21] For fifteen weeks. [22] For eight weeks. [23] For nine weeks. [24] And also 168 hours Summer Practice in Surveying.

SOPHOMORE YEAR.

First Term.	Hrs. per Week.
Mechanical Drawing...	4
Descriptive Geometry—Elements of Projection Drawing (two recitations)...	2
Advanced French; *or*	4
Advanced German ...	4
Analytic Geometry ...	5
General Physics— Three lectures, 3 hrs. Two recitations, 2 hrs.	5
Civil Engineering—Surveying	10

Second Term.	Hrs. per Week.
Mechanical Drawing...	4
Elements of Projection Drawing ...	1
Advanced French; *or*	4
Advanced German ...	4
Mathematics—Differential and Integral Calculus ...	6
General Physics— Three lectures, 3 hrs. Two recitations, 2 hrs.	5
Civil Engineering—Railway Curves ...	10[1]

JUNIOR YEAR.

First Term.	Hrs. per Week.
English—Literature ...	3
Elements of Economics— One lecture, 1 hr. Two recitations, 2 hrs.	3
Applied Mechanics — Statics, Dynamics, Dynamics of rectilinear motion ...	4
Laboratory Course in Physics— One lecture, 1 hr. Laboratory practice, 4 hrs.	5
Civil Engineering—Railroad Engineering ...	10
„ „ Highway Construction	1[2]
„ „ Stereotomy— One recitation, 1 hr. Drawing, 3 hrs.	4
Option.—The Elements of Electrical Engineering (two lectures) ...	2

Second Term.	Hrs. per Week.
Political Science—The American Political System— Two lectures, 2 hrs. Two recitations, 2 hrs.	4
Applied Mechanics—Dynamics, Strength of Materials ...	4
Laboratory Course in Physics— One lecture, 1 hr. Laboratory practice, 4 hrs.	5
Civil Engineering— Geodesy and Practical Astronomy— Three recitations, 3 hrs.; *or* Three lectures, 3 hrs. ...	3[3]
Method of Least Squares (one recitation)...	1
Graphical Statics (Drawing) ...	3
Chemistry—Mineralogy— One lecture, 1 hr. Laboratory work, 1 hr.	2
Chemistry—Metallurgy (lecture) ...	1

SENIOR YEAR.

First Term.	Hrs. per Week.
English—Argumentation ...	2
Applied Mechanics—Strength of Materials, Dynamics of Rigid Bodies ...	2
Mechanical Engineering—Laboratory Practice ...	49[4]
Mechanical Engineering—	
Theoretical Hydraulics (two recitations)	2
Laboratory Practice ...	28[5]
„ „ ...	35[6]
Machine Parts ...	2
Civil Engineering—	
Framed Structures (three recitations or lectures) ...	3
Masonry and Foundations— Three recitations, 3 hrs. Cement Laboratory Practice, 15 hrs.	18
Civil Engineering, Structural Design—(computation and drawing) ...	9
Chemistry—Sanitation (lecture) ...	1

Second Term.	Hrs. per Week.
Mechanical Engineering—	
Laboratory practice ...	56
Applied Hydraulics (two recitations) ...	2
Laboratory practice ...	2[7]
„ „ ...	35
Civil Engineering—	
Structural Design (computation and drawing) ...	9
Arches, Continuous Girders, Suspension Bridges (two recitations or lectures)	2
Water Supply Engineering (two recitations or lectures) ...	2
Sanitary Engineering (two lectures or recitations) ...	2
Thesis ...	12
Chemistry—Sanitation (one lecture) ...	4
	23.

[1] And also 168 hours Summer Practice. [2] Recitation. [3] Also 168 hours Summer Practice. [4] Forty-nine hours a *term*. [5] Twenty-eight hours a *term*. [6] Thirty-five hours a *term*. [7] Twenty-one hours a *term*.

23. *Chemistry, Worcester Polytechnic.*—The Course in Chemistry, the object of which is to afford theoretical, as well as practical, education on that subject, is designed to meet the needs of those who aim at becoming something better than mere analysts—that is, those who study the science from the liberal standpoint.

Programme in Chemistry, Worcester Polytechnic.

FRESHMAN YEAR.

First Term.	Hrs. per Week.
Freehand Drawing	3
English—Advanced Rhetoric	2
Advanced French ; *or*	3
Advanced German	4
Mathematics—Algebra	2
Shop Practice—Wood Work	8[1]
Inorganic Chemistry— Two lectures, 2 hours One recitation, 1 hour Laboratory practice, 2 hours	5

Second Term.	Hrs. per Week.
Freehand Drawing	3
Elementary French, *or*	5
Elementary German	5
History—Modern European (one recitation)	1
Trigonometry	3
Inventional Geometry	2
Inorganic Chemistry— Two lectures, 2 hours One recitation, 1 hour Laboratory practice, 2 hours	5
Qualitative Analysis (Laboratory practice)	11

SOPHOMORE YEAR.

First Term.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements of Projection Drawing (two recitations)	2
Advanced French ; *or*	4
Advanced German	4
Analytic Geometry—Plane, Solid	5
General Physics— Three lectures, 3 hours Two recitations, 2 hours	5
Chemistry—Qualitative Analysis (Laboratory practice)	11

Second Term.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements of Projection Drawing (one lecture)	1
English—English Literature	2
Advanced French ; *or*	4
Advanced German	4
General Physics— Three lectures, 3 hours Two recitations, 2 hours	5
Advanced Inorganic Chemistry (two lectures)	2
Chemistry—Quantitative Analysis— Laboratory practice, 9 hours Lecture or recitation, 1 hour	10
Chemistry—Elementary German and French Chemical Literature (recitation)	1

Option.—Mathematics (Differential and Integral Calculus) in place of Chemistry (Quantitative Analysis).

JUNIOR YEAR.

First Term.	Hrs. per Week.
English—English Literature	2
Elements of Economics— One lecture, 1 hour Two recitations, 2 hours	3
Applied Mechanics — Statics : Dynamics. Dynamics of rectilinear motion	4
Laboratory Course in Physics— One lecture, 1 hour Laboratory practice, 4 hours	5
Electrical Engineering, the elements (two lectures)	2
Chemistry—Quantitative Analysis— Laboratory work, 9 hours Lecture or recitation, 1 hour	10
History of Chemistry (two lectures)	2
Chemistry—Advanced German and French Chemical Literature (recitation)	2

Second Term.	Hrs. per Week.
Political Science—The American Political System— Two lectures, 2 hours Two recitations, 4 hours	4
Laboratory Course in Physics— One lecture, 1 hour Laboratory practice, 4 hours	5
Shop Practice—Foundry work	4[2]
Electrical Engineering—The Elements (lectures)	2
Chemistry—Advanced Quantitative Analysis— Laboratory practice, 9 hours Lecture or recitation, 1 hour	10
Chemistry—Mineralogy— Lecture, 1 hour Laboratory practice, 1 hour	2
Chemistry—Metallurgy (one lecture)	1
Theoretical Chemistry (two lectures)	2
Chemistry—Advanced German and French Chemical Literature (recitation)	2

SENIOR

[1] For fifteen weeks. [2] For seventeen weeks.

SENIOR YEAR.

First Term.	Hrs. per Week.
English—Argumentation	2
Sanitary Chemistry—	
Laboratory practice, 9 hours; Lecture, 1 hour	10
Organic Chemistry—	
Three lectures 3 hrs.; One recitation 1 hr.; Laboratory Practice 8 hrs.	12
Chemistry—	
Sanitation (one lecture)	1
Gas Analysis	2
Industrial Chemistry—(two lectures)	2
Chemistry—Journal Meetings	1

Second Term.	Hrs. per Week.
Electrical Engineering Laboratory	2
Organic Chemistry—	
Three lectures, 3 hours; One recitation, 1 hour; Laboratory practice, 8 hours	12
Chemistry—	
Sanitation (lecture)	1
Industrial Chemistry (2 lectures)	2
Industrial Chemistry	8
Journal Meetings	1
Thesis	12

24. *Electrical Engineering, Worcester Polytechnic.*—The Course in Electrical Engineering is designed to provide a theoretical and practical training for those who will later be engaged in engineering work in connection with electrical industries. The course of study is as follows :—

PROGRAMME IN ELECTRICAL ENGINEERING, WORCESTER POLYTECHNIC.

FRESHMAN YEAR.

First Term.	Hrs. per Week.
Freehand Drawing	3
English—Advanced Rhetoric	2
Advanced French ; *or*	3
Advanced German	4
Mathematics—Algebra	2
Shop Practice—Wood Work	8 [1]
Inorganic Chemistry :—	
Two lectures 2 hrs.; One recitation 1 hr.; Laboratory practice 2 hrs.	5

Second Term.	Hrs. per Week.
Freehand Drawing	3
Elementary French ; *or*	5
Elementary German	5
Trigonometry	3
Inventional Geometry	2
Shop Practice—	
Wood Work	12 [2]
Foundry Work	12 [3]
Forge Work	11 [4]
Inorganic Chemistry—	
Two lectures 2 hrs.; One recitation 1 hr.; Laboratory practice 2 hrs.	5

SOPHOMORE YEAR.

First Term.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements of Projection Drawing (two recitations)	2
Advanced French ; *or*	4
Advanced German	4
Analytic Geometry—Plane : Solid	5
General Physics—	
Three lectures 3 hrs.; Two recitations 2 hrs.	5
Shop Practice—	
Machine work	12 [5]
Forge work	12 [6]
Mechanical Engineering—The Operation of Engines and Boilers	10 [7]

Second Term.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements of Projection Drawing (one lecture)	1
Advanced French ; *or*	4
Advanced German	4
Mathematics—Differential and Integral Calculus	6
General Physics—	
Three lectures 3 hrs.; Two recitations 2 hrs.	5
Shop Practice—	
Machine work	12 [8]
Forge work	12 [9]
Mechanical Engineering—The Operation of Engines and Boilers	10 [10]

JUNIOR

[1] For fifteen weeks. [2] For thirteen weeks and 168 hours Summer Practice. [3] For two weeks only. [4] For two weeks only. [5] For ten weeks. [6] For five weeks. [7] Ten hours a term. [8] For twelve weeks and 168 hours Summer Practice. [9] For five weeks. [10] Ten hours a term.

JUNIOR YEAR.

First Term.	Hrs. per Week.
English—English Literature	2
Elements of Economics— One lecture ... 1 hr. Two recitations ... 2 hrs.	3
Applied Mechanics—Statics, Dynamics, Dynamics of rectilinear motion	4
Laboratory Course in Physics— One lecture ... 1 hr. Laboratory practice 4 hrs.	5
Shop Practice –	
Foundry work	8[1]
Machine work	8[2]
Mechanical Engineering—The Operations of Engines and Boilers	20[3]
Mechanical Engineering- Elementary Steam Engineering (two recitations)... ...	2
Mechanical Engineering — Kinematics of Machinery (Drawing)	4[4]
The Elements of Electrical Engineering—(two lectures)	2
Chemistry—Qualitative Analysis (Laboratory practice)	4

Second Term.	Hrs. per Week.
Political Science—The American Political System— Two lectures ... 2 hrs. Two recitations ... 2 hrs.	4
Applied Mechanics—Dynamics; Strength of Materials	4
Laboratory Course in Physics— One lecture ... ... 1 hr. Laboratory practice... 4 hrs. ...	5
Shop Practice—	
Machine Work	8[5]
Forge Work	8[6]
Mechanical Engineering — Operation of Engines and Boilers	20[7]
Mechanical Engineering—Kinematics of Machinery (Drawing)	4[8]
Electrical Engineering - The Elements of (two lectures)	2
Chemistry—Metallurgy (one lecture) ...	1

SENIOR YEAR.

First Term.	Hrs. per Week.
English—Argumentation	2
Applied Mechanics—Strength of Materials. Dynamics of Rigid Bodies	2
Mechanical Engineering—Thermodynamics (three recitations)	3
Mechanical Engineering-Laboratory practice	49[7]
" " " ...	28[7]
" " " ...	35[9]
Electrical Engineering Design— One lecture, 1 hr. ... ... Design, calculation and drawing, 6 hrs.	7
Electrical Engineering—Measurements and Testing— One lecture, 1 hr,... ... Laboratory practice, 8 hrs.	9
Electrical Engineering—Alternating Currents (one lecture)	1
Chemistry—Gas Analysis	2

Second Term.	Hrs. per Week.
Applied Mechanics—Dynamics of Rigid Bodies; Dynamics of Machinery ...	2
Mechanical Engineering—Advanced Steam Engineering (three recitations) ...	3[10]
Mechanical Engineering-Laboratory practice	56[7]
" " " ...	21[7]
" " " ...	35[7]
Electrical Engineering Design— One lecture, 1 hr. ... ... Design, calculation, and drawing, 6 hrs.	7
Electrical Engineering—Measurements and Testing— One lecture, 1 hr.... ... Laboratory practice, 8 hrs.	9
Electrical Engineering -Alternating Currents (one lecture)	1
Electrical Engineering—Thesis	12

25. *General Science Course, Worcester Polytechnic.*—The details of the Course in General Science which is planned " to meet the needs of young men who expect to assume non-technical positions in commerce and manufacturing, to become teachers, or to enter upon professional study later, are as follows :—

PROGRAMME OF COURSE IN GENERAL SCIENCE, WORCESTER POLYTECHNIC.

FRESHMAN YEAR.

First Term. Subjects.	Hrs. per Week.
Freehand Drawing	3
English, advanced Rhetoric	2
Advanced French ; *or*	3
Advanced German	3
Mathematics—Algebra	2
Shop Practice—Woodwork...	1[11]
Inorganic Chemistry— Two lectures, 2 hrs. ... One recitation,, 1 hr.... Laboratory work, 2 hrs.	5

Second Term. Subjects.	Hrs. per Week.
Freehand Drawing	3
Elementary French ; *or*	5
Elementary German	5
Modern European History, one recitation	1
Trigonometry	3
Inventional Geometry	2
Inorganic Chemistry— Two lectures, 2 hrs. .. One recitation, 1 hr. ... Laboratory practice, 2 hrs.	5
Qualitative Analysis—Laboratory work ...	11

SOPHOMORE

[1] For four weeks only. [2] For eleven weeks. [3] Twenty hours a term. [4] Or one lecture and one recitation a week. [5] For twelve weeks and 168 hours Summer Practice. [6] For six week. [7] A term. [8] Or one lecture and one recitation a week. [9] Thirty-five hours a term. [10] Or draughting-room equivalent. [11] For fifteen weeks.

SOPHOMORE YEAR.

Subjects.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements of Projection Drawing, 2 recitations ...	2
Advanced French	4
Advanced German	4
Analytic Geometry—Plane	5
General Physics— Three lectures, 3 hrs. Two recitations, 2 hrs.	5
Chemistry—Qualitative Analysis—Laboratory work	11

Subjects.	Hrs. per Week.
Mechanical Drawing	4
Descriptive Geometry—Elements or Projection Drawing, one lecture	1
English—English Literature; *or*	3
Mathematics—Differential and Integral Calculus	6
Advanced French; *or*	4
Advanced German	4
General Physics— Three lectures, 3 hrs. Two recitations, 2 hrs.	5
Chemistry—Quantitative Analysis— Laboratory work, 9 hrs, Lecture, 1 hr. ... ... Recitation, 1 hr.	11
Elementary German and French Chemical Literature, one recitation	1

JUNIOR YEAR.

First Term.

Subjects.	Hrs. per Week.
English—English Literature	2
Elements of Economics— One lecture, 1 hr. Two recitations, 2 hrs.	3
History of England, five recitations ...	5
Laboratory Course in Physics— One lecture, 1 hr. ... ... Laboratory practice, 4 hrs.	5
Advanced German and French Chemical Literature, two recitations	2
The Elements of Electrical Engineering, two lectures	2

Second Term.

Subjects.	Hrs. per Week.
Constitutional and Political History of the United States, three recitations ...	3
Political Science—The American Political System— Two lectures, 2 hrs. Two recitations, 2 hrs.	4
Laboratory Course in Physics— One lecture, 1 hr. ... Laboratory practice, 4 hrs.	5
Physics—Electricity and Magnetism— Two lectures; *or* two recitations, 2 hrs. Laboratory practice, 4 hrs.	6
Chemistry—Mineralogy— One lecture, 1 hour ... Laboratory practice, 1 hour	2
Chemistry—Metallurgy, one lecture, 1 hour	1

SENIOR YEAR.

First Term.

Subjects.	Hrs. per Week.
English—Argumentation	2
Advanced Economics— One lecture, 1 hour Two recitations, 2 hours	3
Applied Economics, two recitations... ...	2
Physics—Heat— Two lectures or recitations, 2 hours Laboratory practice, 4 hours	6
Sanitary Chemistry— Laboratory practice, 9 hours One lecture, 1 hour	10
Chemistry—Sanitation, one lecture... ...	1

Second Term.

Subjects.	Hrs. per Week.
English—Higher English Literature ...	2
Economics—Financial Administration, two recitations	2
Political Science—Modern Government— Two recitations	2
Political Science—Journal Meeting... ...	1
Physics—Light— Two lectures or recitations, 2 hours Laboratory practice, 4 hours	6
Physics—Thesis	12
Chemistry—Sanitation—One lecture ...	1

26. *Graduate Courses, Worcester Polytechnic.*—The Graduate Courses leading to the degree of Master of Science are :—

Mechanical Engineering.

Research work in Applied Mechanics (elasticity, power transmission, etc.), Steam Engineering, Hydraulics, Machine Design, with options in Civil Engineering, Electrical Engineering, and Chemistry.

Special work is arranged to meet the requirements of individual students.

Civil Engineering.

Research work in Transportation, including the economic location and maintenance of Steam and Electric Railways, Rope, Chain, Belt, and other conveyors; in Arches and Suspension Bridges, Canal, River, and Harbour Improvement, Irrigation, Mining, and Tunneling, Engineering Specifications and Contracts. Options are offered in Mechanical Engineering, Electrical Engineering, and Chemistry.

Special work is arranged to meet the requirements of each student.

Electrical

Electrical Engineering

First Term.

Water-wheel tests, laboratory practice.
Laboratory practice.
Kinematics of machinery.

Options.

Physics: Heat.
Mechanical Engineering: Theoretical hydraulics.
Mechanical Engineering: Applied hydraulics.
Chemistry: Quantitative analysis.

Second Term.

Electrical Engineering: Practice.
Electrical Engineering: Abstracts.
Electrical Engineering: Thesis.

Options.

Mathematics: Differential equations.
Mechanical Engineering: Machine parts.
Civil Engineering: Surveying.
Civil Engineering: Masonry and Foundations.

There are large libraries connected with the Institute, and a bi-monthly journal is published by it, which greatly contributes to its success. There are also Student Organisations and Athletics.

The fee for tuition, including laboratory charges, is 160 dollars (£32) per year; those holding scholarships pay only a laboratory charge of 10 dollars per year.

27. *Rose Polytechnic Institute.*—This Institute, founded by Chauncey Rose in 1874, and opened in 1883, has five four-year courses, viz., in I. Mechanical Engineering; II. Electrical Engineering; III. Civil Engineering; IV. Architecture; V. Chemistry.

The school limits the number of students it will receive, insists on a large amount of office, field, and shop-work; and demands of its teaching staff considerable experience in the practice of their professions.

The conditions of admission are that a candidate must be 16 years of age (the actual average age of admission is nearly 18); he must either possess a certificate or diploma from commissioned high schools and academies of good standing, or if an approved high school, academic, or collegiate course has not been passed, he must pass an examination in English, history of the United States, Algebra, and Plane Geometry.

Pupils who have resided in Vigo county, Indiana, for more than a year prior to admission are not charged for tuition, but others pay 75 dollars per annum; and every student is charged 25 dollars per annum for the use of materials in chemical and physical laboratories, etc.; breakage is charged extra.

Students find living accommodation at from 3 to 6 dollars per week (12s. 6d. to 25s.).

The "departments" are mathematics, physics, languages, drawing, chemistry, special chemistry, theoretical and applied mechanics, workshop practice, mechanical engineering, electrical engineering, civil engineering, and architecture. There

There are three terms per annum, and in the plan of instruction provision is made for the five parallel courses above mentioned. These five courses are identical during the first two terms of the Freshman year. At the end of the second term, the student must elect between two groups, viz., (1), mechanical and electrical; or (2), civil, architectural, and chemical.

The Mechanical and Electrical courses continue identical to the second term of the Sophomore year; the Civil and Agricultural remain practically identical to the close of the Freshman year. Chemistry differs from all other courses at the beginning of the third term of the Freshman year.

No student is permitted to make special or partial courses.

Theses are required of each member of the senior class. These must be records of independent investigations in some subject included in the scope of the courses.

Physics and chemistry are very largely taught in the laboratory.

The work is as shewn hereinafter.

28. *Mechanical Engineering, Rose Polytechnic.*—The programme is as hereunder:—

PROGRAMME IN MECHANICAL ENGINEERING—ROSE POLYTECHNIC.

FRESHMAN YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Algebra	12	Algebra	12	Elementary Calculus ...	9
Geometry	12	Geometry and Trigonometry	12	Projective Geometry ...	6
Elementary Mechanics ...	9	Elementary Physics ...	3	Trigonometry	9
Language...	9	Language	12	Language	15
Drawing	6	Chemistry	3	Chemistry	3
Practice	14	Drawing	6	Drawing	6
		Practice	14	Practice	14

SOPHOMORE YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Analytical Geometry ...	9	Analytical Geometry ...	9	Higher Algebra... ...	9
Descriptive Geometry ...	6	Descriptive Geometry ...	6	Descriptive Geometry ...	6
Mechanics	6	Mechanics	6	Physics	12
Chemistry	6	Chemistry	6	Chemistry	3
Language	9	Language	9	Language	9
Drawing	6	Drawing...	6	Drawing...	6
Chemical Laboratory ...	5	Chemical Laboratory ...	5	Chemical Laboratory ...	5
Practice...	10	Practice	10	Practice	10

JUNIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Calculus	9	Calculus	12	Analytical Mechanics ...	12
Analytical Mechanics ...	6	Analytical Mechanics ...	6	Applied Mechanics ...	6
Physics	9	Physics	12	Physics	9
Language	9	Language	9	Language	12
Graphics	3	Machine Design... ...	6	Steam Engine	6
Machine Design	6	Physical Laboratory ..	6	Machine Design... ...	8
Physical Laboratory ...	6	Practice	8	Mechanics of Machinery..	9
Practice	10				

SENIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Applied Mechanics ...	15	Applied Mechanics ...	12	Machine Design ...	8
Thermo-dynamics ...	9	Thermo-dynamics ...	6	Engineering Laboratory..	8
Applied Electricity ...	3	Applied Electricity ...	3	Practice	40
Chemical Technology ...	6	Heat and Ventilation ...	3	Thesis[1]	...
Power	3	Power	6		
Hydraulics	3	Power Transmission ...	3		
Machine Design	6	Journal Review ...	3		
Engineering Laboratory...	9	Machine Design ...	6		
Steam Engine	6	Engineering Laboratory..	9		
		Steam Engine	3		
		Gas and Fuel Analysis...	9		

29. *Electrical Engineering, Rose Polytechnic.*—The *Freshman* and *Sophomore Years* are identical with the same years in the *Mechanical Engineering*, with the exception that in the Third Term of the Sophomore year, Electrical Laboratory Work 5 hours per week is included, and Practice is 5 hours instead of 10.

PROGRAMME IN ELECTRICAL ENGINEERING, ROSE POLYTECHNIC.

JUNIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Calculus	9	Calculus	12	Analytical Mechanics ...	12
Analytical Mechanics ...	6	Analytical Mechanics ..	6	Applied Mechanics ...	6
Physics	9	Physics	12	Physics	9
Language	9	Language	9	Language	12
Graphics	3	Machine Design ...	6	Dynamo-electric Machinery	6
Machine Design	6	Physical Laboratory ...	6	Machine Design ...	8
Physical Laboratory ...	6	Practice	8	Steam Engine	6
Practice	10			Practice in Electricity ...	3

SENIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Applied Mechanics ...	15	Applied Mechanics ...	12	Electrical Design ...	8
Thermo-dynamics ...	9	Thermo-dynamics ...	6	Electrical Laboratory ..	8
Dynamo-electricMachinery	9	Dynamo-electric Machinery	12	Practice	40
Power	3	Power	6	Thesis[1]	...
Chemical Technology ...	6	Journal Review... ...	3		
Hydraulics	3	Gas and Fuel Analysis...	3		
Machine Design	6	Electrical Design ...	6		
Engineering Laboratory...	6	Engineering Laboratory	6		
Electrical Laboratory ...	3	Electrical Laboratory ...	3		

30.

[1] Five weeks devoted entirely to Thesis work

30. *Civil Engineering, Rose Polytechnic.*—The course in Civil Engineering is as follows:—

PROGRAMME IN CIVIL ENGINEERING, ROSE POLYTECHNIC.

FRESHMAN YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Algebra	12	Algebra	12	Elementary Calculus ...	9
Geometry	12	Geometry and Trigonometry	12	Projective Geometry ...	6
Elementary Mechanics ...	9	Elementary Physics ...	3	Trigonometry	9
Language	9	Language	12	Language	15
Drawing	6	Elementary Chemistry ...	3	Elementary Chemistry ...	3
Practice	14	Drawing	6	Drawing	6
		Practice	14	Practice	6
				Civil Engineering ...	8

SOPHOMORE YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Analytical Geometry ...	9	Analytical Geometry ...	9	Higher Algebra	9
Descriptive Geometry ...	6	Descriptive Geometry ...	6	Descriptive Geometry ...	6
Mechanics	6	Mechanics	6	Physics	12
Chemistry	6	Chemistry	6	Chemistry	3
Language	9	Language	9	Language	9
Drawing	6	Drawing	6	Drawing	6
Chemical Laboratory ...	5	Chemical Laboratory ...	5	Chemical Laboratory ...	5
Civil Engineering ...	10	Civil Engineering ..	10	Civil Engineering ...	10

JUNIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Calculus	9	Calculus	12	Analytical Mechanics ...	12
Analytical Mechanics ...	6	Analytical Mechanics ...	6	Applied Mechanics ...	6
Physics	9	Physics	12	Physics	9
Language	9	Language	9	Language	12
Graphics	3	Physical Laboratory ...	6	Steam Engine	6
Physical Laboratory ...	6	Civil Engineering ...	14	Civil Engineering ...	17
Civil Engineering ...	16				

SENIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Applied Mechanics ...	15	Applied Mechanics ...	12	Civil Engineering ...	55
Applied Electricity ...	3	Applied Electricity ...	3	Thesis Work[1]	...
Power	3	Power	6		
Chemical Technology ...	6	Civil Engineering ...	30		
Hydraulics	3	Machine Design ...	6		
Engineering Laboratory ...	9				
Civil Engineering ...	21				

31. *Architecture, Rose Polytechnic.*—The course in Architecture is identical with that of Civil Engineering, except that Architecture is substituted for Civil Engineering.

32.

[1] Five weeks devoted entirely to Thesis work.

32. *Chemistry.*—The course in Chemistry is as follows :—

Programme in Chemistry, Rose Polytechnic.

FRESHMAN YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Algebra	12	Algebra	12	Elementary Calculus	9
Geometry	12	Geometry, Trigonemetry	12	Projective Geometry	6
Elementary Mechanics	9	Elementary Physics	3	Trigonometry	9
Language	9	Chemistry	3	Chemistry	3
Drawing	6	Language	12	Language	15
Practice	14	Drawing	6	Drawing	6
		Practice	14	Chemistry	14

SOPHOMORE YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Analytical Geometry	9	Analytical Geometry	9	Higher Algebra	9
Descriptive Geometry	6	Descriptive Geometry	6	Descriptive Geometry	6
Mechanics	6	Mechanics	6	Physics	12
Chemistry	6	Chemistry	6	Chemistry	3
Language	9	Language	9	Language	9
Drawing	6	Drawing	6	Drawing	6
Chemical Laboratory and Chemistry	15	Chemical Laboratory and Chemistry	15	Chemical Laboratory and Chemistry	10
				Practice in Electricity	5

JUNIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Calculus	9	Calculus	12	Analytical Mechanics	12
Analytical Mechanics	6	Analytical Mechanics	6	Applied Mechanics	6
Physics	9	Physics	12	Physics	9
Language	9	Language	9	Language	12
Graphics	3	Physical Laboratory	6	Dynamo-electric Machinery	6
Physical Laboratory	6	Chemistry and Laboratory	14	Steam Engine	6
Chemistry and Laboratory	16			Chemistry	8
				Practice in Electricity	3

SENIOR YEAR.

First Term.	Hrs. per Week.	Second Term.	Hrs. per Week.	Third Term.	Hrs. per Week.
Thermo-dynamics	9	Thermo-dynamics	6	Whole time in Chemistry Thesis[1]	55
Applied Electricity	3	Applied Electricity	3		
Chemical Technology	6	Power	6		
Power	3	Molecular Physics	6		
Hydraulics	3	Chemistry	30		
Molecular Physics	3	Machine Design	6		
Engineering Laboratory	6				
Electrical Laboratory	3				
Chemistry	27				

33.

[1] Five weeks devoted entirely to Thesis work.

33. *General in regard to the Rose Polytechnic.*—The general equipment does not call for special comment. Endeavour has been made to meet the growing demands of electrical engineering. The electrical plant comprises, among other things, a 50 horse-power compound engine, with speed cones giving 200 to 2,500 revolutions per minute on dynamo shaft; a 36-kilowatt alternating current Westinghouse dynamo; transformers of 250 to 2,500 watts capacity of various voltages and manufactures; model lighting plant, 250 lamps with switchboard and station complete, for illustrating principle of installation.

A 75-kilowatt experimental engine, special designed, and capable of being used as a rotary convertor, either direct or inverse, or as a generator for either direct or alternating currents of phases 1–6; transformers, experimental switchboard, circuit-breakers, measuring instruments, etc.; dynamos and motors, series, shunt, and compound wound; a 4,000 watt, 110-volt compound wound dynamo, specially arranged for experimental work; a 25,000 watt, 500-volt generator (a donation by General Electric Company); a multiphase dynamo and motor designed and built by students for experimental work.

The instruments include Weston's current, volt and watt meters; Kelvin's magneto-static instruments; engine-room watt-meters; Carden volt-meter; Ayrton and Perry instruments; Carpentier's instruments.

For alternating current measurements special apparatus is available, such as electro-static volt meters with the following ranges, viz.:—50–200, 300–600, 500–1,800, 400–12,000 volts, Siemen's dynamometers; hot-wire ammeters; non-inductive resistances; large magnet (about 1 ton) with laminated cores and adjustable pole-pieces and coils for study of magnetic induction, resistance and leakage, the comparison of dissipation of energy in open and close circuit transformers, etc.; an automatic curve tracer for the study of magnetic induction, efficiency in conversion, etc.; apparatus for measurement of intensity of field, etc.; series of standard electrical balances, including "deka-ampère" balance for currents from 3 to 300 ampères; "composite" balance for currents of one-tenth of an ampère to 10 ampères, and activity from 10 watts upward; a "centi-ampère" balance for currents between one-hundredth of an ampère to 1 ampère, with resistances suitable for the measurement of potential from 6 to 200 volts; a "composite balance" capable of measuring current up to 300 ampères, potential up to 1,000 volts and activity up to 300,000 watts; are parts of the equipment apparatus of the Institute.

A complete collection of photometric apparatus for the study of the efficiency of lamps, an integrating watt-meter for currents of 2,000 ampères, a series of four step-up transformers for the study and testing of dielectric strength of insulating material may also be mentioned.

Among special features of the apparatus equipment in other departments may be mentioned:—A "Heer transit" for work of great precision; a standard tape tested against the United States Weights and Measures Bureau standards; a considerable amount of hydraulic apparatus for the determination of the law of flow in pipes and from orifices, current meters and apparatus for river gauging and similar material.

The equipment, it will be seen, is adequate for research work as well as demonstration.

34. *The Rensselaer Polytechnic Institute.*—This Institute, situated at Troy, N.Y., was founded in 1824 by the late Hon. Stephen Van Rensselaer as a school for "Instruction in Mathematics, Physics, Chemistry, Geology, and Natural History, with their applications to Civil Engineering, the Arts, Manufactures, and Agriculture," the aim in general being not so much the accumulation of knowledge as the inculcation of correct methods of thought and habits of work. An endeavour is made to make the education in the school general, for the "engineer who has had a certain amount of practice in various branches of the profession is more likely to become eminent as a specialist than one whose theoretical and practical education has been confined within narrow limits." Originally the school gave only Science Courses with the degree A.B.

35. *Course in Civil Engineering, Rensselaer Polytechnic.*—The principal course of instruction in the institute is civil engineering, and is of four years' duration. The degree of Civil Engineer (C.E.) is conferred upon candidates of 17 years and upward who are qualified in that department.

The programmes of the courses in Civil Engineering and Natural Science, which carries with it the degree of Bachelor of Science, are as follows:—

PROGRAMME OF COURSE IN CIVIL ENGINEERING, RENSSELAER POLYTECHNIC INSTITUTE, TROY, N.Y.

FIRST YEAR.

First Term.	*Second Term.*
Chemistry, Theory.	Trigonometry.
Chemistry, Lectures.	Analytical Geometry, Plane.
Algebra.	Mensuration.
French.	French.
Projections, Theory.	Surveying, Theory.
Projections, Drawing.	Surveying, Practice.
Freehand Drawing.	Topographical Drawing.
Elements of Drawing.	Mechanical Drawing.
Lettering.	

A Thesis must be written during the Summer Vacation.

SECOND

[1] Five weeks devoted entirely to Thesis work.

SECOND YEAR.

First Term.	*Second Term.*
Analytical Geometry, Solid.	Descriptive Geometry, Theory.
Differential Calculus.	Descriptive Geometry, Drawing.
Integral Calculus.	Shades and Shadows, Drawing.
Surveying, Theory.	Perspective, Theory.
Surveying, Practice.	Perspective, Drawing.
Chemistry, Qualitative Analysis.	Surveying, Theory.
English Language.	Chemistry, Qualitative Analysis.
	Physics.
	Freehand Drawing.

A Thesis must be written during the Summer Vacation.

THIRD YEAR.

First Term.	*Second Term.*
Surveying, Practice.	Mechanics, Rational.
Geodesy.	Mechanics, Theory.
Electricity, Theory.	Structures.
Electricity, Laboratory Work.	Descriptive Astronomy.
Machine Construction, Theory.	Railroad Curves, Theory.
Machine Construction, Drawing.	Metallurgy.
Road Engineering.	Mineralogy.
Mechanics, Rational.	Assaying.
Botany.	
Map Drawing.	

NOTE:—A Thesis must be written during the Summer Vacation. A three weeks' course in Railroad Engineering practice is required during August and September.

FOURTH YEAR.

First Term.	*Second Term.*
Resistance of Materials.	Hydraulics.
Hydraulics.	Hydraulic Motors.
Sewerage.	Bridge Design.
Bridges and Roofs.	Electrical Engineering, Theory.
Spherical Astronomy.	Electrical Laboratory Work.
Economic Theory of Railroad Location.	Steam Engineering.
Stone Cutting, Theory.	Geology.
Stone Cutting, Drawing.	Water Analysis.
Thermo-dynamics.	Law of Contracts.

NOTE.—A Graduating Thesis must be presented.

36. *Course in Natural Science, Rensselaer Polytechnic.*—The course in Natural Science may be judged from the following programme:—

PROGRAMME OF THE COURSE IN NATURAL SCIENCE, RENSSELAER INSTITUTE.

The studies of the *first two years* are identical with those in Civil Engineering.

THIRD YEAR.

First Term.	*Second Term.*
Subjects.	Subjects.
Theory of Electricity.	Astronomy.
Laboratory Work in Heat, Light, Sound and Electricity.	Metallurgy.
Botany.	Mineralogy, Petrography.
Map Drawing.	Assaying.
Chemistry, Elementary Quantitative Analysis.	Chemistry, Organic.
	Chemistry, Blow-Pipe Analysis.

NOTE.—A Thesis must be written during the Summer Vacation.

FOURTH YEAR.

First Term.	*Second Term.*
Subjects.	Subjects.
Metallurgy, Iron Metallurgy.	Geology, Lithology.
Chemistry, Quantitative Analysis, Analysis of Commercial and Industrial Products.	Palæontology.
	Chemistry, Quantitative Analysis, Volumetric and Gravimetric Analysis.
	Water Analysis.
	Law of Contracts.

NOTE.—A Graduating Thesis must be presented.

37.

37. *Special Courses, Rensselaer Polytechnic.*—In addition to the courses just referred to, there are Special Courses in *Electrical Engineering, Chemistry*, and *Assaying*. These are intended for "students who are not able to spend the time necessary to take a complete course and obtain a degree." The course in Electrical Engineering is two years in duration, and the time is regulated according to the requirements of students. There are also courses on *Water Analysis* (which has connected with it a special laboratory for the bacteriological and chemical examination of water), in *Surveying and Railroad Engineering* of a practical character, and in *Highway Engineering and Road Construction.*

The conditions of admission are that the candidate be at least 16 years of age, and pass an examination in Arithmetic, Plane Geometry, Algebra, Geography and English.

The Institute has at its disposal a fine library, a chemical, physics, and mechanical laboratory, an astronomical observatory, and a gymnasium.

Originally students in engineering devoted about eight weeks to learning the use of instruments and their applications in surveying; eight weeks were spent in subjects connected with the mechanical power in civil engineering; four weeks in hydraulic work; four weeks in the study of steam, wind power, electricity, etc. Now these courses are, as seen, all thoroughly organized.

Theses may take either a theoretical or practical form, the mention of a few will give a sufficient indication. The following are theses recently produced:—(1) The manufacture of superphosphates; (2) The oxidation of organic matter in potable water; (3) Hardening of steel and its effect upon the ultimate resistance; (4) Effect of overstrain on metals; (5) Design of a pair of triple-expansion marine engines to develope 10,000 i.h.p.; (6) Design for shears of 150 tons capacity; (7) Design for a Bloom mill of a steel-rail plant, capacity 1,000 tons per diem; (8) Design for turbine plant developing 2,500 h.p. with a head of 45 feet, etc., etc.

38. *Concluding Remarks.*—The types of higher professional or technical education given in the University and Polytechnics, whose programmes have been outlined in this chapter, are fairly representative.

The type of work attempted in other establishments will be given in subsequent chapters.

A point worthy of notice is the large number of establishments throughout the United States where students can get higher technical instruction at a moderate cost. This is a great advantage.

Another feature worthy of notice is the easy condition of entrance; it is not comparable to the martriculation condition of our University, or to the entrance-conditions of the Technical High Schools of Germany and Austria. Owing to this, the four years cannot be regarded as approaching in academic or practical thoroughness the same number of years spent in a European Technical University.

The easy condition allows a larger number to be moderately qualified, but hinders the attainment of that thoroughness of knowledge which is characteristic in Europe.

CHAPTER XXXVI.

The Massachusetts Institute of Technology, Boston.

[G. H. KNIBBS.]

1. *Introduction.*—During the Commissioner's stay in Boston a visit was made to the Massachusetts' Institute of Technology, one of the renowned establishments in the United States of America for technical training. On this occasion a sketch was most kindly prepared by the authorities of the Institute, giving an account of its development. The following general sketch, as far as section 10, is practically *verbatim et literatim* a reproduction of the account.[1] The details of curricula are, of course, compiled.

2. *General Statement and Historical Sketch.*—"The close of the United States' Civil War in 1865 found the Northern States stimulated to an unprecedented degree of industrial activity, disbanding armies setting free thousands of men in the prime of life eager to develope the material resources of the country. Only three years before (2nd July, 1862) the National Congress had passed an Act assigning Government land to the several States, to assist in the maintenance in each State of at least one college, of which the main object should be the promotion of those branches of education connected with agriculture and the mechanic arts. In consideration of such aid, all of these colleges are required to give instruction in military science and tactics. Prior to this time, facilities for education in applied science were exceedingly meagre. The industrial situation and the national grant combined to cause the speedy foundation of many colleges of applied science, which have had an incalculable effect on the subsequent national development.

The Massachusetts Institute of Technology is one of these colleges. Its inception, however, dates further back, being due primarily to the foresight and enthusiasm of William Barton Rogers, long a professor at the University of Virginia, who came to Boston in 1853. Professor Rogers presented plans for the foundation of an institute of technology to his associates in Boston, and to the members of the successive legislatures.

In his "Scope and Plan" of the School of Industrial Science Professor Rogers says:—

It is the design of this school to afford to the public at large opportunities for instruction in the leading principles of science as applied to the arts, and at the same time to provide for systematic students of the applied sciences the means of a continuous and thorough training in the studies and practice appertaining to these subjects.

In pursuing this subject, it is intended to give to the teachings such scope and method that, while imparting a due measure of knowledge, and cultivating the habits of observation and exact thought, so conducive to the progress of invention and the development of an enlightened industry, they may help to extend more widely the elevating influence of a generous and scientific culture.

And elsewhere:—

In the features of the plan here sketched it will be apparent that the education which we seek to provide, although eminently practical in its aims, has no affinity with that instruction in mere *empirical routine* which has sometimes been vaunted as the proper education for the industrial classes. *We believe, on the contrary, that the most truly practical education, even in an industrial point of view, is one founded on a thorough knowledge of scientific laws and principles,* and which unites with habits of close observation and exact reasoning a large general cultivation. We believe that the highest grade of scientific culture would not be too high a preparation for the labours of the mechanic and manufacturer; and we read in the history of social progress ample proofs that the abstract studies and researches of the philosopher are often the most beneficent sources of practical discovery improvement.

The Massachusetts Institute of Technology was incorporated in 1861 by the State of Massachusetts, *for the purpose of instituting and maintaining a Society of Arts, a Museum of Arts, and a School of Industrial Science, and aiding generally by suitable means the advancement, development, and practical application of science in connection with arts, agriculture, manufacture, and commerce.*

Mainly owing to the extraordinary growth of the School of Industrial Science, the Museum of Arts has not yet been established.

The Society of Arts was the first section of the Institute of Technology to be established, holding its first meeting in 1862, and maintaining them at fortnightly intervals during the eight months of the year. At these meetings, which are freely open to the public, many epoch-making inventions and processes have been presented. The valuable work done by this Society, the results of which are embodied in its Proceedings, and subsequently in the "Technology Quarterly," has been in a measure overshadowed, however, by the development of the School of Industrial Science, which alone is usually meant by the term Massachusetts Institute of Technology.

The regular courses of instruction of the School of Industrial Science were not opened until October, 1865. The courses of instruction offered were mechanical engineering, civil and topographical engineering, practical chemistry, geology and mining, building and architecture, general science and literature. Without attempting even a sketch of the history of the Institute, its progress may be indicated by a few comparisons. The number of students has increased from 72, in 1865–6, to more than 1,400 in 1901–2; the instructing staff from 10 to nearly 200, *the proportion of instructors to students being now, as always, notably large.* Thirty-four classes have graduated, numbering about 2,500 persons, a large proportion of whom occupy posts of responsibility in connection with the industries of the nation. It may be noted, however, that, in consequence of the rapid growth of the school, more than half of these graduates belong in the last eight classes, and have thus had insufficient time for gaining professional distinction."

3.

[1] Marks of quotation will shew where the report is reproduced. The Commissioner takes this opportunity of expressing his warm thanks for courtesy shewn during the visit to the Institute.

3. *Significance of the Work of the Institute.*—" As to the significance of the Institute's work, *in its relations to educational progress in the United States*, something may be added, without attempting a detailed discussion of precise questions of priority. The Faculty of the Institute believes it may be fairly affirmed that the Institute has led in the development of laboratory instruction in Physics and Chemistry to students in large classes; in the organisation and equipment of mining and metallurgical laboratories for the instruction of students by the actual treatment of ores in large quantities; in the establishment of a laboratory for teaching to large classes the uses and properties of steam; in the establishment of a laboratory for the comprehensive testing of strength of materials in commercial sizes by students; in the establishment of departments of architecture, electrical engineering, sanitary engineering, chemical engineering, and naval architecture; and in the recognition of the importance of mechanic arts instruction for engineering students."

4. *Character of the Instruction.*—" The aims of the Institute as a school are now, as always, to provide instruction in the sciences and their application to the arts in combination with such general studies as are essential for a liberal education. Thirteen distinct courses are offered, each of four years' duration, as follows :—

I. Civil Engineering.
II. Mechanical Engineering.
III. Mining Engineering and Metallurgy.
IV. Architecture.
V. Chemistry.
VI. Electrical Engineering.
VII. Biology.
VIII. Physics.
IX. General Studies.
X. Chemical Engineering.
XI. Sanitary Engineering.
XII. Geology.
XII. Naval Architecture.

For the satisfactory completion of any one of these, the degree of *Bachelor of Science* is conferred by the Institute. Of the thirteen courses, eight give their students scientific and practical training for the various engineering professions; four others, viz., those in chemistry, physics, biology, and geology, with a larger proportion of pure science, offer preparation either for professional practice, for teaching, or for scientific investigation. The course in general studies combines thorough general scientific training, with a wide range of philosophical studies.

The following table shews the distribution of students by professional departments for the school-year 1901–1902 :—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
215	274	171	117	104	224	25	27	29	60	23	5	108

Besides these, there were 30 specials in the first year, making a total of 1,412.

Within most of the regular courses *the student is given, by means of options, a considerable latitude in the selection of the branch to which he will specially devote his energies in the later years of his study.* Thus in civil engineering he may elect sanitary and hydraulic engineering, geodesy, or an advanced course in railroad engineering and management; in mechanical engineering, marine engineering, locomotive construction, mill engineering, or heating and ventilation; in architecture, architectural engineering, and landscape architecture, etc.

While the Institute is *primarily and essentially a school of applied science*, its curriculum has always comprised a considerable amount of literary, historical, and economic study. There has been no time since the foundation of the Institute when its degree could be obtained without studies in these lines carried through at least three years.

The Institute is at once a college and a professional school. Students come to it at 18 years of age, with such preparation as can be obtained in the public high schools, including algebra, plane and solid geometry, English literature and composition, United States history or ancient history, elementary French or elementary German—requirements which might be met by the students in a good German gymnasium at perhaps two years younger. Entering as a rule on examinations, these students receive first, *a year of general drill, mainly in mathematics through analytic geometry, chemistry, and mechanical drawing.* A partial choice of professional course is made at the middle of the first year, but divergence is slight until the beginning of the second year. In the second year physics and calculus are common to most courses, and elementary professional subjects are undertaken; for example, surveying for students in civil and sanitary engineering, mechanism for those in other engineering courses, qualitative and quantitative analysis for those in the chemical courses, etc. In the third year a large proportion of time, and in the fourth year nearly the entire time is devoted to professional subjects.

Throughout all courses the following principles are fundamental:—

(1st) *Close personal relations between instructors and students* in order that the students' needs and capacities may be adequately gauged, good habits of study formed and faults corrected. This requires division of our classes into numerous sections for recitation with proportionately less dependence upon the results of final examination.

(2nd) *A careful adjustment of the theoretical and experimental work* in the courses of instruction, so that the work of the class-room shall prepare the student for that in the laboratory, which in turn serves to fix methods and results in his memory, as well as to give him capacity for new experimental work.

(3rd) *The importance of guiding the student rather than merely instructing him.* The function of the teacher is not so much to impart formulated knowledge as to develope power of ascertaining facts and overcoming difficulties. To this end the student is trained to work with less and less dependence upon his teachers, until in his final year he is required before receiving his degree to prepare a thesis, which is usually an account of a considerable research."

5. *The Student Body of the Institute.*—" While the Institute includes the name Massachusetts in its official title, it is not local in its constituency. A large proportion of students—usually about 60 per cent.—come from the surrounding cities and towns, but nearly all States in the Union are usually represented, and *a considerable number of students come from other countries, and indeed from all parts of the world.*

Oversight

Oversight of students is exercised to much a greater degree than in a German University, but to a materially less extent than in most academic colleges with dormitories. *The students live in homes and boarding-houses of their own choice* in different parts of the city and surrounding towns. A considerable minority, however, organise "fraternities" owning or renting houses. Such fraternities have a continuous and in most cases an intercollegiate character, and undoubtedly enrich the student life of their members.

A student's work is carefully supervised by systematic co-operation of his instructors, and any student known to be neglecting his work is promptly disciplined by advice, requirement of discontinuance of particular subjects, or, in exceptional cases, by requirement to withdraw from the school. During the first two years each student's work is reported four times to the Secretary and by him to the parents or guardian, or to the student himself if he is of age. In all years reports of standing are collected and distributed in January and May, accompanied by any needful admonitions on the part of the Faculty. This oversight tends to separate progressively those students who cannot or will not shew sufficient interest and industry, and those who are not really fitted for scientific studies. The general tone of the student body under this system is one of earnest effort."

6. *Organisation and government of the Institute.*—"The organisation of the Institute may be described as follows:—

The central property-holding body is called the Corporation, and consists of not more than fifty members, including three representatives of the State of Massachusetts. New members are elected by the Corporation in case of vacancies by death or resignation, and a considerable proportion of the present membership is composed of graduates of the school. The Corporation elects a President, who is at the same time President of the Faculty, of the School of Industrial Science and of the Society of Arts. The Corporation also elects a Secretary, a Treasurer, and various Committees. The *Executive Committee* consists of the President, the Treasurer, and five others, and has authority to act for the Corporation in nearly all matters. The Corporation, through its Executive Committee, appoints the instructing staff, and determines their duties and salaries. It has charge of all property and accounts through the *Treasurer* and a *Bursar* responsible to him. *The Faculty determines the curriculum of the school,* subject to the control of the Corporation, *which is, however, seldom directly exercised.* Associated with the President in the conduct of the administrative work are a Secretary, a Librarian, and a considerable staff of assistants. Beside the direct routine connected with instruction, a large amount of work is involved in the conduct of correspondence and the issue of numerous publications of information."

7. *Cost of Buildings and Equipment.*—"The Institute now occupies eight buildings of the ground area and present valuation shewn on the following table:—

		Approx.
Rogers Building, 92′ x 145′	$200,000	£41,667
Walker Building, 90′ x 156′	150,000	31,250
Engineering Building A, 52′ x 148′	90,000	18,750
Engineering Building B, 66′ x 58′	57,875	12,057
Henry L. Pierce Building, 58′ x 160′	154 297	32,145
Work Shops	30,000	6,250
Boiler and Power House	26,917	5,607
Gymnasium	7,968	1,660

(These figures do not in all cases represent the actual cost of the respective buildings, as a progressive reduction has been made for depreciation.)

The Henry L. Pierce Building—the newest of these—is of fire-proof construction, with steel doors so arranged that fire can be easily controlled and confined to the room or section in which it originates. Special attention has been paid to the heating and ventilation, and an abundance of properly tempered fresh air is delivered to all parts of the building. *The electric light shades are the result of special investigation, and the glass in the windows in laboratories on the southerly exposure is ribbed to diffuse the light.*[1] Indirect heating, *i.e.,* the forcing of heated air by fans, is applied to all the buildings erected since the Rogers building.

Plans are now in preparation for two additional buildings to be constructed in the near future. One of these will be occupied by the department of *Physics and Electrical Engineering,* the other will be a memorial of the late President Walker, and will be devoted to the social and physical interests of students. It will include a large and well-equipped gymnasium and reception-room and library, and numerous smaller rooms for special purposes. Toward the erection of this building the Alumni of the Institute have contributed more than $100,000."

8. *Budget of the Institute.*—"The annual Budget varies greatly from year to year with fluctuations in the number of students and their distribution among the departments. For the year ending 30th September, 1900, current expenses amounted to $335,000, of which salaries constituted nearly $250,000, the other larger items being laboratory supplies and libraries $41,000, general expenses $16,000, repairs $12,000. Among salaries administration should be charged with between $15,000 and $20,000, although the exact separation is not practicable.

The tuition fee is two hundred dollars a year (£42), *which is much less than the average cost to the Institute.* During the past year this has amounted to $350 (£73), per student, including interest on the cost of property.

The property held by the Institute in September, 1900, was valued at $3,339,441. Of this, $1,761,854 was invested in various stocks and bonds, $1,466,587 in land, buildings, and equipment, and $111,000 in sundries and cash. The total income was $347,138, $200,745 being from students' fees, and the balance largely from the interest on various funds and gifts from the State of Massachusetts and the United States. The expenses were $355,726; made up of salaries, for instruments, $198,838; for administration, $23,351, and for labour, $26,883; department supplies, $41,488; rents, $12,575; repairs, $12,406; and general expenses, $16,707."

9.

[1] At an educational conference held in Sydney some speakers ridiculed attention to such matters as the above. In the greater world, where experience and better education prevail, a different view is taken.

9. *Library and Publications.*—"The Institute's library contains 53,851 volumes and 15,235 pamphlets and maps, divided into the department libraries which are located in the rooms of the respective departments and are kept thoroughly up to date.

The publications of the Institute include the annual catalogue and programme, the annual report of the President and Treasurer, and the special descriptive circulars of the Institute, the Technology Quarterly and Proceedings of the Society of Arts, and the Technology Review,—a graduates' magazine.

A list of publications of the Institute and of its past and present officers and students exhibits effectively the amount of scientific work centred in the school (a copy is sent herewith)."

10. *Graduates of the Institute.*—"The graduates of the Institute have a general organisation including all, and by semi-annual meetings and committee work form an effective auxiliary in maintaining the outside reputation of the school. The character of their work has been in the past the best advertisement of the school and the best aid to its graduates in securing prompt foothold in industrial establishments. The public recognition of their efficiency has become so general that, except in seasons of temporary business depression, it is difficult to find graduates for vacant places."

11. *The detailed Curricula.*—The preceding sketch gives an excellent general idea of the Institute and its splendid work. It needs, however, to be supplemented by the detailed curricula for each course, if one would know exactly the difference between the *Higher Technical Colleges* and *Trade Schools.* The following information, derived from the "Annual Catalogue" of the Institute, for the year 1901–2, and the Special Catalogue of the Department of Architecture, is compiled in such a form as to clearly shew the time devoted to the various subjects in each of the courses.

12. *The Course in Civil Engineering.*—The Course in Civil Engineering is thus referred to in the Catalogue:—

"The Course in Civil Engineering is designed to give the student sound training, both theoretical and practical, in the sciences and principles upon which professional practice is based. Particular care is taken to enforce the application of the principles taught, and the student is made familiar with the use of Engineering instruments and with the usual problems of practice.

"Civil engineering is the broadest in scope of the engineering professions, being the parent stem from which have diverged all the other branches; but, even though these have become recognised as distinct professions, the field of civil engineering still remains so large that no one can become expert in its whole extent. It covers topographical engineering; the building of railroads, harbours, docks, and other works serving the purposes of commerce and transportation; municipal engineering, including the construction of sewers, waterworks, roads, and streets; structural engineering, including the construction of bridges, buildings, walls, foundations, and all fixed structures; hydraulics, the development of water power, and other branches. All of these branches of engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class-room, the drawing-room, the field, and the testing laboratory.

"In the comparatively advanced work of the fourth year, the student is offered a choice between three options or lines of study, viz., a general option in civil engineering, an option in which more than usual attention is devoted to highways, railroads, and railroad management, and an option giving special attention to geodosy and topography.

"In the summer vacation following the third year four weeks are devoted to a course of field-work in geodetic and topographic surveying, including hydraulic measurements and geological field-work. This course is open to all students, and is is required of those taking the geodetic option."

The details of the Curriculum are as hereunder. It should be noted that throughout the following programmes there are 15 weeks in a term, but where the hours per week has a subscript number the course last only the number of weeks shewn by the subscript.

CIVIL ENGINEERING. (I)

FIRST YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Algebra	2	Analytic Geometry	4
Plane Trigonometry	2	Spherical Trigonometry	1
Inorganic Chemistry; Chemical Laboratory	7	Inorganic Chemistry; Qualitative Analysis; Chemical Laboratory	6
Mechanical Drawing and Geometrical	6	Mechanical Drawing and Descriptive Geometry	12
Freehand Drawing	1	Freehand Drawing	2
French[1] *or*	3	French[1] *or*	3
German[2]	3	German[2]	3
Rhetoric and English Composition	2	United States History	2
Military Science	—	Military Science	—

SECOND YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Surveying and Plotting	6	Surveying and Plotting	5
Topographical Drawing	2	Mechanism	2
Elements of Astronomy	1	Dynamical Geology	3
Differential Calculus	3	Integral Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5	Physics-Electricity, Optics (lectures)	5
Descriptive Geometry	5	German *or*	3
German *or*	3	French	3
French	3	English Literature and Composition	2
English Literature	1		
European History (since 1815)	2		

THIRD

[1] Students entering on French take German in their second and third years.
[2] Students entering on German take French in their second and third years.

THIRD YEAR.

First Term.	Hrs. per Week.
Railroad Engineering	2
Railroad Drawing and Field-work	4
Advanced Surveying	2
Stereotomy	4
Structural Geology	2
Physics: Heat	2
Physical Laboratory	2_7
General Statics; Stress in Frames; Strength of Materials	4_{20}
German, *or*	3
French	3
Political Economy and Industrial History ...	2

Second Term.	Hrs. per Week.
Railroad Engineering	3_{10}
Highway Engineering...	3_5
Drawing and Field-work	5
Advanced Surveying	2
Theory of Structures	2_{10}
Stratigraphic Geology...	2
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics; Theory of Elasticity ...	3_{10}
German, *or*	3
French	3
Political Economy and Industrial History ...	1
Business Law	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Theory of Structures: Bridges and similar structures	3
Hydraulics	3
Industrial Electricity	1

Options.

1	Sanitary and Hydraulic Engineering ...	3
	Bridge Design	6
	Foundations	1
	Hydraulic Measurements	3_7
	Practical Astronomy	1
	Steam Engineering	2
	Metallurgy of Iron	1
2	Railroad Signals (time specially arranged each year).	
	Railroad Engineering	2
	Railroad and Highway Design	3
	Railroad Management	2
	Bridge Design	6
	Foundations	1
	Steam Engineering	2
	Metallurgy of Iron	1
3	Bridge Design	5
	Geodesy *and*	3
	Astronomy	1
	Hydraulic Measurements	3_7
	Method of Least Squares	2
	Physical Laboratory	4

Second Term.	Hrs. per Week.
Theory of Structures: Bridges and similar Structures	3
Thesis...	—

Options.

1	Advanced Structures	2
	Hydraulic Engineering	3
	Elements of Geodesy	1
	Bridge Design	6
	Sanitary and Hydraulic Design... ...	2
	Sanitary Science and Public Health ...	1
	Steam Engineering	2
	Engineering Laboratory	2_8
2	Advanced Structures	2
	Railroad Engineering	3
	Railroad and Highway Design	3
	Bridge Design	6
	Building Construction	1
	Steam Engineering	2
	Engineering Laboratory...	2^8
3	Hydraulic Engineering	3
	Geodesy	12
	Geodetic Laboratory	—
	Physical Laboratory	3

13. *Course in Mechanical Engineering.*—The course in Mechanical Engineering aims at equipping "the student with such training in pure and applied mathematics as shall qualify him to deal with the engineering problems of his profession from the most favourable standpoint. It attempts by instruction, both theoretical and practical, to acquaint him with engineering practice, and to give him a proper groundwork upon which to base a professional career. The more strictly professional work of the course may be classified as follows:—

"Mathematics, physics, and applied mathematics are given outside the Department, the last including the study of the strength of materials, with practice in testing.

"Recitation-room work of the Department proper begins with the study of mechanism, the construction of gear-teeth, etc., and is continued by courses on machine tools and cotton machinery. Courses are given on valve-gears, thermodynamics, steam boilers, and the theory of the steam engine. The fourth year instruction includes applied dynamics, further study of steam engineering, hydraulics and hydraulic motors, foundations, and industrial management, and a course in machine design, combining study and drawing. The option is given of courses in locomotive construction, mill engineering, marine engineering, and heating and ventilation.

"Drawing-room work begins in the second year. The students make working drawings from measurements, and the drawings necessary in connection with the course in mechanism and gear construction. In the third year they make detail and assembly drawings from machinery, and this is followed by mechanism designs and boiler drawings.

"Instruction in mechanic arts includes carpentry, pattern-making, forging, chipping, filling, and machine-tool work.

"Engineering laboratory work begins with drill in steam-engine tests in the second term of the third year, and is continued throughout the fourth year, including tests of boilers, pumps, power, etc., and a large amount of investigation."

The

The details of the curriculum are as follows:—

Mechanical Engineering (II).

The First Term of the First Year is identical with that of Civil Engineering.

FIRST YEAR.

Second Term.	Hrs. per Week.
Analytic Geometry	4
Theory of Equations	1_{10}
Inorganic Chemistry; Qualitative Analysis; Chemical Laboratory	6
Mechanical Drawing, and	6_{5}
Descriptive Geometry	6_{10}
Freehand Drawing	2
French,[1] *or*	5
German[2]	3
United States History	2
Military Science	—

SECOND YEAR.

First Term.	Hrs. per Week.
Principles of Mechanism	2
Drawing	2
Carpentry and Wood-turning	4
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
Descriptive Geometry	5
German, *or*	3
French	3
English Literature	1
European History (since 1815)	2

Second Term.	Hrs. per Week.
Mechanism: Gear-teeth; Machine-tools; Cotton Machinery	3
Drawing	6
Pattern Work	2
Foundry (elective)	2
Integral Calculas	3
Physics: Electricity, Optics (lectures)	5
German, *or*	3
French	3
English Literature and Composition	2

THIRD YEAR.

First Term.	Hrs. per Week.
Steam Engineering: Valve-gears; Thermodynamics	3
Drawing	6
Industrial Electricity	1
Dynamo-electric Measurements	1
Forging	4
Elements of Differential Equations	2_{5}
Physics: Heat	2_{8}
Physical Laboratory	2_{7}
General Statics	2
German, *or*	3
French	3
Political Economy and Industrial History	2

Second Term.	Hrs. per Week.
Steam Engineering; Boilers	3
Drawing, Design, and use of Surveying Instruments	5
Engineering Laboratory	2
Forging, and	6_{8}
Chipping and Filing	6_{5}
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics	3
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Steam Engineering	2_{8}
Machine Design	9
Hydraulics	3
Dynamics of Machines	3_{9}
Engineering Laboratory	4
Chipping and Filing	6_{7}
Machine-tool Work	6_{10}
Strength of Materials; Friction	3
Heating and Ventilation	1
Metallurgy of Iron	1

Options.

1. Marine Engineering	3_{6}
2. Locomotive Construction	3_{6}
3. Mill Engineering	3_{6}
4. { Heating and Ventilation	2
Dynamo-electric Machinery	2
Hygiene of Ventilation	1_{5}

Second Term.	Hrs. per Week.
Hydraulic Motors	2
Engineering Laboratory	4
Machine-tool Work	6_{10}
Strength and Stability of Structures; Theory of Elasticity	3
Foundations	2_{5}
Industrial Management	2_{5}
Thesis	—

Options.

1. Marine Engineering	3
2. Locomotive Construction	3
3. Mill Engineering	3
4. Heating and Ventilation	3

14.

[1] Students entering on French take German in their second and third years.
[2] Students entering on German take French in their second and third years.

14. *The Course in Mining Engineering and Metallurgy.*—The course in Mining Engineering and Metallurgy is thus referred to in the Catalogue :—

"The mining and metallurgical engineer has, of necessity, demands made upon him in a great variety of lines. The policy of the school is to give him the underlying principles of mathematics, physics, chemistry, mineralogy, geology, mining engineering, and metallurgy, as well as some practical knowledge of mechanical, civil, and electrical engineering. Thus equipped, he can, after graduation, take up specialised work, with the expectation of carrying it on successfully.

"With the studies included under the first option, the course is a general one, adapted to the needs of students who prefer not to make an immediate choice between professional specialities. Those who have not a serious reason for doing otherwise are advised to take this option.

"The second group of optional studies is arranged with reference to mechanism and the steam-engine, the time necessary being taken from surveying, geology, and mining engineering. This course is adapted especially for the iron and steel metallurgist.

"Valuable opportunities are offered for observation and field-work in the summer schools of mining and metallurgy, and in mineralogical excursions, as well as in the ample laboratories of the Institute.

"For students able to devote an additional year to professional study, a definite graduate course of one year, which may lead to the degree of Master of Sciences, has been arranged. In view of the exceedingly varied demands likely to be made upon the professional mining engineer, such an extension of the course offers peculiar advantages, even if taken without the intention of obtaining a higher degree."

The details of the curriculum are as shewn hereunder :—

Mining Engineering and Metallurgy (III).

The First Year is identical with that of Mechanical Engineering,

SECOND YEAR.

First Term.	Hrs. per Week.
Mineralogy *and*	4
Blowpipe Analysis[1]	2
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
German, *or*	3
French	3
English Literature	1
European History (since 1815)	2
Options.	
1. Surveying and Plotting	6
1. Topographical Drawing	2
2. Descriptive Geometry	5
2. Principles of Mechanism	2

Second Term.	Hrs. per Week.
Blowpipe Silver Assay[1]	2
Integral Calculus	3
Physics: Electricity, Optics (lectures)	5
German, *or*	3
French	3
English Literature and Composition	2
Options.	
1. Surveying and Plotting	5
1. Structural and Chemical Geology	3
1. Dynamical Geology	3
2. Mechanism: Gear-teeth; Machine Tools	2
2. Theoretical Chemistry	2
2. Drawing	3

Note.—Summer Course in Practical Mining or Metallurgy (Elective). Field-work in Mineralogy (Elective).

THIRD YEAR.

First Term.	Hrs. per Week.
Assaying	4
Analytical Chemistry: Qualitative Analysis (lectures and laboratory)	8
Physics: Heat	2_8
Physical Laboratory	2_7
General Statics	2
German, *or*	3
French	3
Political Economy	2
Options.	
1. Mining Engineering	3
1. Historical Geology	3
1. Industrial Electricity	1
1. Dynamo-electric Measurements	1
2. Steam Engineering; Thermodynamics; Valve-gears	3
2. Drawing	5

Second Term.	Hrs. per Week.
Quantitative Analysis (lectures and laboratory)	8
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics	3
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1
Options.	
1. Mining Engineering	3
1. Theoretical Chemistry	2
2. Steam Engineering; Boilers	3
2. Engineering Laboratory	2

FOURTH

[1] Students in Option 2 are required to take *either* Blowpipe Analysis or Blowpipe Silver Assay.

FOURTH YEAR.

First Term.	Hrs. per Week.
Mining Engineering: Ore-dressing ...	2
Memoirs, Laboratory Reports	2
Metallurgy (non-ferrous)	2
Metallurgy of Iron	1
Metallurgical Laboratory	8
Quantitative Analysis (lectures and laboratory)	13
Heat Measurements	9
Hydraulics	3
Strength of Materials; Friction	3

Second Term.	Hrs. per Week.
Mining Engineering; Mining and Metallurgical Machinery ...	2
Memoirs, Laboratory Reports	2
Metallurgy (non-ferrous)	3
Metallurgical Laboratory	14
Quantitative Analysis (lectures and laboratory)	12
Thesis	—
Options.	
1. Quantitative Analysis (additional)	13
2. Engineering Laboratory	4

15. *Course in Architecture.*—The Architectural Course aims at preparing its members:—

"Not only for their years of work as subordinates, when accuracy, rapidity, and taste in drawing and design, with knowledge of detail, will be the most useful qualifications, but also for their subsequent independent career, when the value of technical knowledge will become important.

"Opportunities are offered for one or two years of graduate professional work. The value of such continuous and uninterrupted study at a period when the students are best fitted for it cannot be overestimated. The time may be devoted to advanced design in continuation of either Option 1 or Option 2.

"To Option 1, the general course in architecture, have been recently added Option 2, Architectural Engineering, and Option 3, Landscape Architecture

"Options 1 and 2 are identical to the middle of the third year. The professional work of these options begins in the second year, with the study of the five orders and their applications. The student is made familiar with the materials and principles of construction by lectures and visits to buildings.

"In the third year the time devoted to architectural history is much increased, specifications are discussed, and sufficient practice in working drawings is given to enable the student to be of immediate service on entering an architect's office.

"A technical course in heating and ventilation is given in the third year, illustrated by the study of important public buildings in the city. In the fourth year, applied mechanics and graphical statics are applied to general practice, and exercise is given in designing trusses and in the various problems occurring in modern construction.

"Practice in architectural design is continued throughout the course, and also instruction in drawing from the cast and from life. Facility in rendering is gained by a course in water colour and pen-and-ink drawing.

"Option 2 includes, in the second term of the third year and the whole of the fourth year, extended courses in structures and structural design, in place of the purely architectural design and allied work of Option 1."

The detailed curriculum is developed as hereunder:—

ARCHITECTURE (IV).

The *First Term* of the *First Year* is identical with that of the other courses.

Second Term.	Hrs. per Week.
Materials of Architecture	1
Shades and Shadows	2_{8}
Analytic Geometry	4
Theory of Equations	1_{10}
Mechanical Drawing,[1] and	12
Descriptive Geometry	12_{12}
Freehand Drawing	3
French,[2] *or*	3
German[3]	3
United States History	2
Military Science	—

SECOND YEAR.

First Term.	Hrs. per Week.
Elementary Design	6
Architectural History	1
Materials	1
Shades and Shadows	2_{8}
Freehand Drawing	4
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
German, *or*	3
French	3
English Literature	1
European History (since 1815)	2

Second Term.	Hrs. per Week.
Design	7
Architectural History	1
Perspective	1
Stereotomy	1
Freehand Drawing	4
Integral Calculus	3
Physics: Electricity, Optics (lectures)	5
German, *or*	3
French	3
English Literature and Composition	2

THIRD

[1] Twelve hours per week for three weeks.
[2] Students entering on French take German in their second and third years.
[3] Students entering on German take French in their second and third years.

THIRD YEAR.

First Term.	Hrs. per Week.
Design	10
Architectural History	2
Perspective	1
Specifications and Working Drawings	4
Freehand Drawing	4
Heating and Ventilation	3
General Statics	2
German, *or*	3
French	3
Political Economy	2

Second Term.	Hrs. er Week.
Architectural History	2
Freehand Drawing	4
Pen-and-ink	1
Strength of Materials	3
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1

Options.

1.	Design	14
	Building Stones	2
2.	Structures	2
	Structural Design	8_8
	Heating and Ventilation	2

FOURTH YEAR.

First Term.	Hrs. per Week.
History of Construction	1
European Civilisation and Art	3
Pen-and-ink	1

Options.

1.	Design	19
	Constructive Design	7_8
	History of Ornament	1_{10}
	Life Class	4
	Water-colour	2
	Strength of Materials	3_7
2.	Acoustics	1_5
	Structures	3
	Structural Design	19
	Strength of Materials	3

Second Term.	Hrs. per Week.
Business Relations	1
European Civilisation and Art	3
Sanitary Science and Public Health	1
Design: Thesis	26

Options.

1.	History of Ornament	1_{10}
	Life Class	4
	Modelling	2
	Pen-and-ink	1
	Water-colour	2
	Colour	1_5
2.	Structures	3
	Building Stones	2
	Laboratory Tests of Building Materials	3_7

The Option on Landscape Architecture will be best understood from the following:—

Option 3.

LANDSCAPE ARCHITECTURE IV (*continued*).

The *first year* is identical with that of the previous course (Architecture, Options 1 and 2).

SECOND YEAR.

First Term.	Hrs. per Week.
Architectural Elementary Design	5
Shades and Shadows	2_8
Horticulture	2
Biology	1
Surveying	6
Topographical Drawing	2
Freehand Drawing	4
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
German, *or*	3
French	3
English Literature	1
European History	2
Architectural History	1

Second Term.	Hrs. per Week.
Architectural Design	4
Perspective	1
Horticulture	2
Botany	2
Dynamical Geology	3
Surveying	5
Freehand Drawing	4
Physics: Electricity, Optics (lectures)	5
German, *or*	3
French	3
English Literature and Composition	2
Architectural History	1

THIRD YEAR.

First Term.	Hrs. per Week.
Design	8
Architectural History	2
Horticulture	4
Elements of Natural Landscape	1_{10}
Curves and Earth-work	2
Advanced Surveying (Stadia)	2
Structural Geology	2
Freehand Drawing	4
German, *or*	3
French	3
Political Economy	3

Second Term.	Hrs. per Week.
Landscape Design	10
Horticulture	4
Highway Engineering	3_5
Advanced Surveying (Plane Table)	2
Architectural History	2
Freehand Drawing	4
Field Work and Drawing	4
Economic Geology	4
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1
Pen-and-ink	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Landscape Architecture	1
Landscape Design	11
Horticulture	4
Specifications and Working Drawings (Landscape Gardening)	2
Sanitary Engineering and Drainage: Masonry	4
History of Ornament	1_{10}
Life Class	4
Pen-and-ink	1
Water-colour	2
European Civilisation and Art	3

Second Term.	Hrs. per Week.
Landscape Architecture	1
Horticulture	4
History of Ornament	1_{10}
Business Relations	1
Life Class	4
Modelling	2
Pen-and-ink	1
Water-colour	2
Public Health and Sanitation	1
Photography	1
European Civilisation and Art	3
Landscape Design: Thesis	16

16. *The Course in Chemistry.*—The Course in Chemistry is stated to be—

"Designed to prepare students to conduct manufacturing operations based on chemical principles, to act as consulting chemists, to become teachers of chemistry, or to engage in scientific research.

"Five series of optional studies, including respectively engineering, analytical, sanitary, metallurgical, and physico-chemical subjects, and extending throughout the course, have been established in order to allow students to prepare themselves more thoroughly for these special lines of chemical work. This specialisation does not, however, preclude a thorough general training in all the important branches of chemistry.

"The class-room work consists of courses of lectures on inorganic chemistry. The non-chemical studies, such as mathematics, mechanical drawing, physics, biology, mineralogy, English, history, political economy, and language, are selected with reference to their bearing on chemical work, or for their general educational value.

"The student spends a large part of the four years in the laboratories, the work being arranged as follows:—In the first year there is general laboratory practice, in which the student is taught the nature of chemical processes and the use of chemical apparatus, and is drilled in accurate habits of observation. Qualitative chemical analysis is begun in the second term of the second year. Quantitative analysis follows in the second term of the second year, and continues throughout the course. Practice in the industrial, sanitary, organic, and physico-chemical laboratories follows in the third and fourth years. Effort is made to develope self-reliance in the student, so that he may be fitted to make his way without assistance. To this end he is required to make investigations, involving an original research and reference to chemical literature in English, French, and German."

The detailed programme is:—

CHEMISTRY (V).

FIRST YEAR.

First Term is identical with those of the other courses.

Second Term.	Hrs. per Week.
Inorganic Chemistry; Qualitative Analysis; Chemical Laboratory	10
Theory of Equations	1_{10}
Elements of Plane Analysic Geometry	2
Mechanical Drawing	6
Freehand Drawing	2
Wood and Metal Turning	2
French *or*	3
German	3
United States History	2
Military Science	—

SECOND YEAR.

First Term.

	Hrs. per Week.
Qualitative Analysis (lectures and laboratory)	8
Mineralogy	4
Blow-pipe Analysis	2
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
German, or	3
French	3
English Literature	1
European History (since 1815)	2

Options.

1, 5, Differential Calculus	3
1. Descriptive Geometry	5
2, 3, 4. Elements of Differential and Integral Calculus	3

Second Term.

	Hrs. per Week.
Quantitative Analysis (lectures and laboratory)	10
Physics: Electricity, Optics (lectures) ...	5
Physical Laboratory	2
Physical Measurements (lectures)	1
German or	3
French	3
English Literature and Composition ...	2

Options.

1, 5. Integral Calculus	3
2, 3, 4. Dynamical Geology, or	3
Chemical Geology...	2
General Biology	1
Industrial Microscopy	2

THIRD YEAR.

First Term.

	Hrs. per Week.
Quantitative Analysis (lectures and laboratory)	14
Industrial Chemistry...	2_{5}
Physics: Heat	2_{8}
Physical Laboratory...	2_{7}
Industrial Electricity	1
German or	3
French...	3
Political Economy	2

Options.

1. Mechanism and Drawing...	4
2, 3. Air, Water, and Food Analysis ...	6
4. Industrial Chemical Laboratory... ...	6
Sugar Analysis	2_{10}
5. Differential Equations	3

Second Term.

	Hrs. per Week.
Quantitative Analysis (lectures and labora-(tory)	14
Theoretical Chemistry	2
Organic Chemistry	1
Industrial Chemistry	3_{10}
Assaying	2
German or	3
French	3
Political Economy and Industrial History...	1
Business Law	1

Options.

1, 2. Industrial Chemical Laboratory ...	5
3. Bacteriology	4
4. Assaying (additional)	4
Quantitative Analysis (additional) ...	17
5. Water Analysis	2
Electrical and Heat Measurements ...	2

FOURTH YEAR.

First Term.

	Hrs. per Week.
Organic Chemistry (lectures)	3
Organic Analysis	5
Organic Preparations and Reactions ...	13
Molecular Weight Determinations... ...	1
Theoretical Chemistry	1
Elements of Non-ferrous Metallurgy ...	2
Metallurgy of Iron	1
Testing of Oils	2

Options.

1. Valve-gears and Drawing...	8
2. Proximate Technical Analysis *or* ...	6
Textile Colouring	6
3. Bacteriology of Water and Sewerage...	2
Industrial Biology	4
4. Non-ferrous Metallurgy	2
Ore-dressing	2
Laboratory Reports	1
Metallurgical Laboratory	8
5. Electro-chemistry	2
Kinetic Theory of Gases	1

Second Term.

	Hrs. per Week.
Organic Chemistry (lectures)	3
Gas Analysis	1
Chemical Equilibrium	1
Thermo- and Electro-chemistry	1
Electrical and Heat Measurements... ...	2
History of Chemistry	1
Thesis Reports	1
Thesis	...

Options.

1. Engines and Machines	4
2. Physico-chemical Laboratory	2
3. Sanitary Science and Public Health ...	1
Microscopical Analysis of Water and Sewerage	2
4. Non-ferrous Matallurgy	3
Mining Machinery	2
Energetics	2
Physico-chemical Laboratory	2

17. *Course in Electrical Engineering.*—The course in Electrical Engineering is designed—

"To meet the needs of young men desirous of entering upon the practice of any of the various applications o electricity in the arts. Its leading studies are physics, especially theoretical and applied electricity, mechanical engineering, and mathematics.

"The work in engineering runs parallel with the electrical subjects, since in all branches of electrical engineering a sound knowledge of mechanics and motors, of measurements of power, and of the means of its transmission, etc., is essential. Thus the second year includes the studies of mechanism, mechanic arts, and drawing, and the third year, applied mechanics, steam engineering, and hydraulics. Certain of these subjects are also continued in the fourth year.

"An extended course in physics begins with the second year, and is continued, by lectures, recitations, and laboratory work to the end of the third year. A portion of this is devoted to electricity; and at the middle of the second year special lectures, readings, and recitations on this topic are begun, by which the study of the theory of electricity is continued until the end of the fourth year. Work in the physical laboratory begins at the middle of the second year, and continues into the fourth year, leading up to general electrical measurements and testing. Throughout the fourth year, in the laboratory of electrical engineering, the student pursues courses in the practical study of dynamo-electric machinery. Extended courses on the technical applications of electricity to the telegraph, the telephone, electric lighting, and the electrical generation, transmission, and utilisation of power, etc., are given in the third and fourth years, the latter year being chiefly occupied with electrical study and research.

"A series of advanced mathematical topics also forms an important part of the work.

"A graduate course in electrical engineering, one year in duration, and leading to the degree of Master of Science, has recently been instituted."

The details of the course are as hereunder:—

Electrical Engineering (VI).

The First Year is identical with that of Mechanical Engineering.

Second Year.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Physics: Mechanics, Wave-motion, Electricity (lectures) ...	5	Physics: Electricity, Optics (lectures) ...	5
Acoustics ...	2	Physical Laboratory: Mechanics, Optics ...	2
Principles of Mechanism ...	2	Physical Measurements (lectures) ...	1
Differential Calculus ...	3	Theoretical Electricity...	2
Descriptive Geometry ...	5	Mechanism: Gear-teeth, machine-tools ...	2
Carpentry *and* ...	2	Drawing ...	5
Metal-turning ...	2	Integral Calculus ...	3
German *or* ...	3	Carpentry and Wood-turning ...	2
French ...	3	German *or* ...	3
English Literature ...	1	French ...	3
European History (since 1815) ...	2	English Literature and Composition ...	3

Third Year.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Physics: Heat (lectures) ...	2_8	General Electrical Measurements (laboratory)	3
Physical Laboratory: Heat ...	2_7	Theoretical Electricity...	2_8
Theoretical Electricity ...	2_8	Periodic Currents ...	1_7
Methods of Telegraphy ...	2_8	Electrical Measuring Instruments and Methods (lectures) ...	2_7
Elements of Industrial Electricity ...	1	Steam Engineering: Boilers ...	3
Steam Engineering: Valve-gears; Thermodynamics ...	3	Engineering Laboratory ...	2
Drawing ...	3	Drawing ...	2
Differential Equations...	3	Strength of Materials; Kinematics and Dynamics ...	3
General Statics...	2	German *or* ...	3
German *or* ...	3	French ...	3
French ...	3	Political Economy and Industrial History ...	1
Political Economy ...	2	Business Law ...	1

Fourth Year.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Technical Applications of Electricity to Telephony, Electric Lighting, Electrical Generation of Power ...	4	Technical Applications of Electricity ...	5
Methods of Dynamo Testing (lectures)[1] ...	—	Telephony; Direct Current Practice[1] ...	—
General Electrical Testing ...	5	Alternating Current Practice[1] ...	—
Electrical Engineering Laboratory: Testing of Dynamos ...	5	Methods of Dynamo Testing (lectures)[1] ...	—
Electrical Measuring Instruments and Methods (lectures) ...	2_{10}	Principles of Dynamo Design[1] ...	—
Theory of Periodic Currents ...	1	Telephone Engineering[1] ...	—
Photometry[1] ...	—	Electrical Engineering Laboratory; Measurements of Dynamo-electric Machinery; Special Methods ...	5
Steam Engineering ...	2_8	Theory of Alternating Current Machinery ...	2
Dynamics of Machines ...	3_5	Engineering Laboratory ...	4
Hydraulics ...	3	Economics of Corporations ...	2
Engineering Laboratory ...	4	Thesis ...	—
Strength of Materials; Friction ...	3		
Options.			
Railroad Signals[1] ...	—		
Propagation of Electric Waves ...	1		

18.

[1] Hours arranged for each year.

18. *Course in Biology.*—The course in Biology is thus referred to :—

"The course in Biology affords especially a training in those sciences which pertain to living things. Those who take it usually intend to become physicians or teachers, to fill positions connected with public works or the civil service, or to engage in some of the various fermentation industries as experts in bacteriology or microscopy.

"Some of the best medical schools are already requiring for admission special training such as this course affords, and it is believed that for the scientific or professional study of medicine no preparation can be superior to a liberal education in which the prominent features are chemistry, physics, and biology, comparative anatomy and embryology, comparative physiology, and microscopic anatomy, bacteriology, and sanitary science.

"The need for thoroughly-trained teachers of the natural sciences was never greater than to-day, and for several years many teachers in actual service have resorted to the Institute for instruction in biology. There is good reason to believe that the public school service now offers an inviting career to educated teachers, and that the course in biology, owing to its broad and comprehensive character, affords a sound preparation for persons intending eventually to teach, or to direct teaching, in the natural sciences.

"The course in biology is adapted for those also who desire to enter the civil service, with boards of health, water boards, or sewer departments on the sanitary side, as bacteriologists or microscopists, as well as for those who intend to devote themselves to processes connected with dairying, vinegar-making, pickling, canning, cold storage, or other food-making, fermentation, or food-preserving industries.

"The subjects of study and their sequence are shewn on the opposite page. Abundant facilities for the regular practical work of the course are provided in the various laboratories of the Institute, especially those of chemistry, physics, physiology and bacteriology.

"Opportunities are provided also for special advanced work in general bacteriology, industrial biology, and sanitary science ; in physiology and hygiene ; and, to some extent, in zoology and botany."

The detailed programme is as hereunder :—

Biology (VII).

FIRST YEAR.

The *First Term* is identical with that of the other *Courses*.

Second Term.	Hrs. per Week.
Inorganic Chemistry ; Qualitative Analysis ; Chemical Laboratory	6
Industrial Microscopy ...	2
Elements of Plane Analytic Geometry ...	2
Theory of Equations ...	1_{10}
Mechanical Drawing ...	4
Freehand Drawing ...	2
French *or* ...	3
German ...	3
United States History ...	2
Military Science ...	—

SECOND YEAR.

First Term.	Hrs. per Week.
General Biology ...	5
Qualitative Analysis (lectures and laboratory)	10
Mineralogy and Blow-pipe Analysis ...	6
Physics: Mechanics, Wave-motion, Electricity (lectures) ...	5
German *or* ...	3
French ...	3
English Literature ...	1
European History ...	2

Second Term.	Hrs per Week.
Cryptogamic Botany ...	5
General Zoology ...	2
Quantitative Analysis (lectures and laboratory)	8
Dynamical Geology ...	3
Physics: Electricity, Optics (lectures) ...	5
German *or* ...	3
French ...	3
English Literature and Composition... ...	1

THIRD YEAR.

First Term.	Hrs. per Week.
Comparative Anatomy...	8
Anthropology ...	1
Organic Chemistry (brief course) ...	1
Sanitary Chemistry ...	7
Historical Geology ...	3
Physics: Heat ...	2_8
Physical Laboratory ...	2_7
German *or* ...	3
French ...	3
Political Economy ...	2

Second Term.	Hrs. per Week.
General Bacteriology ...	4
Microscopic Anatomy ...	5
Comparative Anatomy and Embryology ...	8
Theoretical Chemistry ...	—
Physical Laboratory ...	2
German *or* ...	3
French ...	3
Political Economy and Industrial History ...	1
Business Law ...	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Comparative Physiology ...	5
Physiological Laboratory ...	5
Theoretical Biology ...	1
Microscopic Anatomy ...	3
Bacteriology of Water and Sewage ...	2
Industrial Biology ...	4
History of the Inductive Sciences ...	1
Journals ...	1

Options.

1. Organic Chemistry ...	9
Mammalian Anatomy ...	3
2. Palæontology ...	4
Climatology ...	2

Second Term.	Hrs. per Week.
Sanitary Science and Public Health ...	1
Theoretical Biology ...	2
Comparative Physiology ...	5
Journals ...	1
Vital Statistics... ...	1
Thesis ...	—

Options.

1. Microscopical Analysis of Water and Sewage ...	2
Municipal Sanitation ...	2
2. Descriptive Sociology *or* ...	3
Structural and Chemical Geology... ...	4

19.

19. *Course in Physics.*—The course in Physics embraces—

"A series of studies adapted to the needs of those who wish to become teachers of physics, or who desire to enter upon a course in pure science, whether with a view to its further continuance or wholly as a matter of training. Its leading features are a thorough and continuous study of the various branches of physics and a treatment of mathematics advanced considerably beyond the requirements of any of the technical courses. Inorganic, theoretical, analytical, and organic chemistry occupy a position next in prominence to mathematics, and of hardly less importance. Options are so arranged that the student may select more advanced work in either mathematics or chemistry.

"Historical and other allied subjects and the modern languages are continued throughout the first three years, and the latter may be further prolonged if desired. Chemistry may be continued to the end of the course, and mathematics, pure and applied, is required throughout the whole four years. Physics begins with the second year, and, in lectures, readings, recitations, and laboratory exercises, extends to the close of the course. A large amount of experimental work is performed, and an experimental investigation is undertaken during the fourth year in connection with the preparation of the thesis. At all times it is sought to encourage the spirit of original research, and to impart an understanding of the principles upon which scientific investigation, especially in quantitative measurement, should be conducted.

"Beyond the particular alternative studies set forth in the course scheme, a certain further liberty of substitution may be allowed by the Faculty in the case of students in Course VIII who are fitting themselves for some special line of work."

The Physics Course allows an option in Electro-Chemistry.

The programme in detail for the ordinary course runs as hereunder:—

Physics (VIII).

First Year is identical with that of Mechanical Engineering.

SECOND YEAR.

First Term.	Hrs. per Week
Physics: Mechanics, Wave-motion, Electricity (lectures) ...	5
Acoustics ...	2
Qualitative Analysis (lectures and laboratory)	9
Descriptive Astronomy ...	2
Microscopy ...	2
Differential Calculus ...	3
German, *or* ...	3
French ...	3
English Literature ...	1
European History (since 1815) ...	2
Options.	
1. Qualitative Analysis (additional) ...	9
2. Determinants ...	1

Second Term.	Hrs. per Week.
Physics: Electricity, Optics (lectures) ...	5
Physical Laboratory: Mechanics, Optics ...	2
Physical Measurements (lectures) ...	1
Theoretical Electricity ...	2
Quantitative Analysis (lectures and laboratory)	6
Theoretical Chemistry ...	2
Integral Calculus ...	3
German, *or* ...	3
French ...	3
English Literature and Composition ...	2

THIRD YEAR.

First Term.	Hrs. per Week.
Physics: Heat (lectures) ...	2_{8}
Physical Laboratory: Heat ...	2_{7}
Theoretical Electricity ...	2_{8}
Elements of Industrial Electricity ...	1
Photometry ...	1
Organic Chemistry ...	1
Chemistry of Solutions and Molecular-weight Determinations ...	2
Differential Equations ...	3
Method of Least Squares ...	2
German, *or* ...	3
French ...	3
Political Economy ...	2
Options.	
1. Quantitative Analysis ...	14
2. Quaternions ...	2

Second Term.	Hrs. per Week.
Physical Laboratory: Optics or Heat and Electrical Measurements ...	4
Electrical Measuring Instruments and Methods (lectures) ...	1_{8}
Physico-chemical Laboratory ...	1
Theoretical Electricity ...	2_{8}
Periodic Currents ...	1_{7}
Chemical Equilibrium ...	1
Thermo-chemistry ...	1
Analytical Mechanics ...	3
German, *or* ...	3
French ...	3
Political Economy and Industrial History ...	1
Business Law ...	1
Options.	
1. Quantitative Analysis ...	14
2. { Theory of Surfaces ...	2
2. { Advanced Calculus and Definite Integrals	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Heat Measurements *and* ...	5
Electrical Testing ...	—
Theory of Periodic Currents ...	1
Electrical Measuring Instruments and Methods (lectures) ...	2_{10}
General Theory of Light ...	2
Kinetic Theory of Gases ...	1
Electro-chemistry ...	2
Physical Colloquium ...	2
Fourier's Series; Laplace's Coefficients ...	2
History of Science ...	1
Options.	
1. Organic Chemistry ...	9
2. Analytical Mechanics ...	3

Second Term.	Hrs. per Week.
Theory of Potential or Theory of Alternating Current Machinery ...	4
General Theory of Light ...	3
Energetics ...	2
Fourier's Series; Laplace's Coefficients ...	2
Principles of Scientific Investigation ...	3
Physical Colloquium ...	2
Physical Research: Thesis ...	—
Options.	
1. Special Work; Chemistry or Physics ...	—[1]
2. Analytical Mechanics ...	3

20.

[1] Time arranged for each year.

20. *Course in Electro-Chemistry.*—In Physics there is an option in *Electro-Chemistry.* This course is referred to in the following terms:—

"The rapid advances now being made in the applications of electricity in chemical and metallurgical industries call for a training which has not hitherto been fully provided in the courses in Electrical Engineering, Physics, or Chemistry as given at the Institute or elsewhere. The problems arising in these arts require for their solution the combined training of the physicist, the chemist, and, to a less degree, of the engineer.

"To meet the wants of students desiring to prepare themselves for entrance into the various electro-chemical industries, the Institute has decided to establish a course of study leading particularly to this end.

"The course in Physics has for a number of years furnished opportunity for such study to a considerable extent, and the new group of subjects is laid out as an option in this course.

"It comprehends, first, an extended consideration of electricity and electrical testing, together with those portions of electrical engineering which are especially related to machinery employed in electro-chemical work; second, a thorough course in chemistry, including analytical, industrial, organic, and theoretical chemistry; and, third, a detailed study of the theory of electro-chemistry and its industrial applications.

"The option in electro-chemistry aims to provide the education necessary for the investigation of the many new problems which the development of novel processes is certain to bring forth, and also to impart the professional skill requisite for the installation, testing, and operation of apparatus and machinery by which electrical energy is applied in chemical, metallurgical, and allied processes. The instruction given, moreover, is of such a broad character, particularly in electricity and chemistry, that a student completing this option should be well prepared to undertake various lines of electrical or chemical work other than electro-chemistry."

The details of this option are as hereunder:—

PHYSICS (*Option* 3) (VIII—*continued*).

Electro-Chemistry.

The *First Year* is identical with that of Courses II, III, VI, X, and XIII.

SECOND YEAR.

First Term.	Hrs. per Week.
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
Qualitative Analysis (lectures and laboratory)	7
Differential Calculus	3
Descriptive Geometry	5
Carpentry and Metal-turning	4
German, *or*	3
French	3
English Literature	1
European History	2

Second Term.	Hrs. per Week.
Physics: Optics (lectures)	5
Physical Laboratory: Mechanics, Optics	2
Physical Measurements (lectures)	1
Theoretical Electricity	2
Quantitative Analysis (lectures and laboratory)	8
Integral Calculus	3
Mechanical Engineering Drawing	3
German, *or*	3
French	3
English Literature and Composition	2

THIRD YEAR.

First Term.	Hrs. per Week.
Physics: Heat (lectures)	2_{8}
Physical Laboratory: Heat	2_{7}
Theoretical Electricity	2_{8}
Industrial Electricity	1
Analytical Chemistry	9
Industrial Chemistry	2_{5}
Differential Equations	3
Mechanism	2
Mechanical Engineering Drawing	2
German, *or*	3
French	3
Political Economy	2

Second Term.	Hrs. per Week.
General Electrical Measurements (laboratory)	4
Electrical Measuring Instruments and Methods (lectures)	2_{7}
Theoretical Electricity	2_{8}
Periodic Currents	1_{7}
Theoretical Chemistry	2
Industrial Chemistry	3_{10}
Organic Chemistry	1
Assaying	2
Valve-gears; Drawing	8
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1

FOURTH YEAR.

First Term.	Hrs. per Week.
Electro-chemistry (lectures)	2
Electro-chemical Laboratory	3
Electrical Engineering: Electrical Generation of Power; Dynamo Testing (lectures)[1]	3
Electrical Testing; Electrical Engineering Laboratory	10
Electrical Measuring Instruments and Methods (lectures)	2_{10}
Theory of Periodic Currents	1
Heat Measurements	3
Theoretical Chemistry	1
Gas Analysis	1
Non-ferrous Metallurgy	2_{10}
Physical Colloquium	2
Options.	
Metallurgical Laboratory	8
Organic Chemistry (laboratory)	9

Second Term.	Hrs. per Week.
Applied Electro-chemistry (lectures)	2
Electro-chemical Laboratory	3
Electro-metallurgy	1
Electrical Engineering	3
Direct Current Practice[1]	—
Alternating Current Practice[1]	—
Transmission of Power (lectures)[1]	—
Electrical Engineering Laboratory	5
Engines and Machines	2
Energetics (Thermo-dynamics)	2
Chemical Equilibrium	1
Thermo-chemistry	1
Physical Colloquium	2
Thesis	—

21.

[1] Time specially arranged for each year.

21. *Course in General Studies.*—The course in General Studies is designed especially—

"For students who wish to secure an education based upon scientific study and experiment, but including a larger amount of history, economics, language, and literature than is possible in technical courses. It is adapted to the needs of those who expect to engage in trade, banking, manufacturing, or journalism, or in the teaching of social or political science. For administrative positions in business, a careful knowledge of political and social relations is essential; and it is believed that the origin, growth, and laws of political and industrial society can best be approached through the methods used in natural science. The uniform requirement of the Institute in physics and a considerable share of the general training in chemistry are preserved in this course. From the study of biology, including botany and zoology, as a basis, the student is prepared to proceed to the study of man in society, and to consider the history and significance of social institutions, such as the family, the state, and the church. Physical science, biology, anthropology, social science, and history, political and industrial history, and international law, thus present, throughout the course, a definite, progressive relationship.

"This course keeps in view the fact that in practical life, as in intellectual, success must depend largely upon breadth and flexibility of mind; and that intelligent and appreciative study of literature contributes to the fullest development of these qualities. The study of the history and development of the English language is made to lead the way to a careful survey of English literature, the effort being to make the work not mechanical, but sympathetic and vital.

"Other especial features of the department of General Studies are more extended study of modern languages; a continuous course of historical study, directed especially toward the political and social history of England and the United States; drill in the essential principles of English composition; and an orderly study of economics, including its theory and history, with courses in industrial and commercial history and geography, finance, and statistics. The student may be permitted to substitute certain subjects in other courses, as biology or mathematics, provided his individual aptitudes justify such a liberty."

General Studies (IX).

The *First Term* of the *First Year* is identical with that of the other Courses.

Second Term.	Hrs. per Week.
United States History	2
Logic and Argumentative Composition	3
French,[1] *or*	3
German[2]	3
French,[1] sight-reading	3
Elements of Plane Analytic Geometry	2
Theory of Equations	1_{10}
Graphic Statistics	4
Freehand Drawing	2
Military Science	—

Second Year.

First Term.	Hrs. per Week.
European History (since 1815)	2
History of England	2
Political Economy	2
Economic Problems	1
English Literature[3]	—
French[4]	3
German (elementary)	3
General Biology	4
Physics: Mechanics, Wave-motion, Electricity (lectures)	5

Second Term.	Hrs. per Week.
History of England	2
English Literature and Composition	2
French[4]	3
German	3
Zoology and Botany	3
Dynamical Geology	3
Physics: Electricity, Optics (lectures)	5
Physical Laboratory	2

Third Year.

First Term.	Hrs. per Week.
European Civilisation and Art	3
English Composition (advanced course)	1
Financial History of United States[5]	3
Statistics	2
Commercial Geography[5]	2_5
Anthropology	1
German, with sight-reading	5
Physics: Heat, *or*	2_8
Industrial Electricity	1
Options.	
History of England in the 16th and 17th centuries	2
Theories and Methods of Social Reform	2
English Literature to 1560	3

Second Term.	Hrs. per Week.
European Civilisation and Art	3
History of Commerce[5]	3
Descriptive Sociology	3
Geology	3
Business Law	1
German, with sight-reading	5
Options.	
History of England in the 16th and 17th centuries	2
Theories and Methods of Social Reform	2
English Literature: 1560–1660	3
French	2

FOURTH

[1] Students entering on French take German in their second and third years.

[2] Students entering on German take French in their second and third years.

[3] Twenty (20) hours for the term.

[4] The course in French Literature is also recommended.

[5] Alternating studies.

FOURTH YEAR.

First Term.	Hrs. per Week.
Comparative Politics	3
International Law	2
Taxation and Administration[1]	3
English Literature: 1660–1780	3
Physiology and Personal Hygiene	2
Climatology	2
Options.	
History of Era of French Revolution	2
Municipal Government and Administration	2
Statistics of Sociology	3
Argumentation	2
Language: Special Work in French or German, or Elements of Spanish or Italian	4

Second Term.	Hrs. per Week.
Comparative Politics	3
History of Industry[1]	3
History and Elements of Philosophy	3
English Literature: 1780–1860	3
Sanitary Science and Public Health	1
Thesis	—
Options.	
History of Era of French Revolution	2
Municipal Government and Administration	2
Banking and Finance	2
History of Economic Theory	—
Contemporary Literature	2
Journalism	2
Language: First Term continued	4

22. *Course in Chemical Engineering.*—The course in Chemical Engineering is officially stated to be adapted to meet the needs of—

"Students of mechanical engineering who wish to devote a portion of their time to the study of the application of chemistry to the arts, thus enabling them to take positions as engineers having to deal with problems of construction and administration in connection with manufactures involving chemical principles.

"The general engineering studies in the course in Chemical Engineering coincide, for the most part, with those of the course in Mechanical Engineering, a portion of the mechanic arts and drawing of the latter course being replaced, however, by chemical subjects. A course of instruction in the fourth year is devoted to a discussion of the machinery used in manufacturing and applied chemistry, including the methods of transportation, evaporation and distillation, refrigeration, and other similar topics.

"The instruction in industrial and applied chemistry is arranged with reference to the needs of this course, and attention is directed to the methods of conducting the mechanical operations in various manufacturing processes; and at the same time the chemical principles upon which the operations rest are thoroughly taught.

"The instruction in the fourth year has been so arranged that the student can exercise a certain choice as to the topics to which he wishes to devote special attention. Thus, he may receive instruction in textile colouring, in case he expect to find employment in the textile industries; in heat measurements, to fit him for operations involving the use of furnaces; in organic chemistry, if he intends to engage in the manufacture of dyes or other organic products; and in machine design or theoretical chemistry, as supplementing the general mechanical and chemical training of the course."

The curriculum is defined as hereunder:—

CHEMICAL ENGINEERING (X.).

The First Year is identical with that of Electrical Engineering.

SECOND YEAR.

First Term.	Hrs. per Week.
Qualitative Analysis (lectures and laboratory)	9
Principles of Mechanism	2
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
Descriptive Geometry	5
Germany, *or*	3
French	3

Second Term.	Hrs. per Week.
Quantitative Analysis (lectures and laboratory)	5
Mechanism; Cotton Machinery; Machine-tools; Gear-teeth	3
Drawing	6
Integral Calculus	3
Physics: Electricity, Optics (lectures)	5
German *or*	3
French	3

THIRD YEAR.

First Term.	Hrs. per Week.
Industrial Chemistry	2_5
Organic Chemistry	1
Steam Engineering; Thermo-dynamics; Valve-gears	3
Drawing	6
Elements of Differential Equations	2_5
Industrial Electricity	1
Physics: Heat	2_8
Physical Laboratory	2_7
General Statics	2
German, *or*	3
French	3
English Literature	1
European History (since 1815)	2

Second Term.	Hrs. per Week.
Industrial Chemistry	3_{10}
Industrial Chemical Laboratory	5
Steam Engineering: Boilers	3
Drawing	2
Engineering Laboratory	2
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics	3
German, *or*	3
French	3
English Literature and Composition	2

FOURTH

[1] Alternating studies.

FOURTH YEAR.

First Term.	Hrs. per Week.
Applied Chemistry	4
Testing of Oils	2
Gas Analysis	1
Steam Engineering	2_{8}
Engineering Laboratory	4
Metallurgy of Iron	1
Elements of Non-ferrous Metallurgy	2_{10}
Strength of Materials; Friction	3
Dynamics of Machines	3_{5}
Carpentry and Wood-turning	4
Political Economy	2
Options.	
Textile Colouring	6
Heat Measurements	6
Organic Chemistry	3
Hydraulics and Hydraulic Measurements	5
Machine Design	15

Second Term.	Hrs. per Week.
Applied Chemistry: Memoirs	2
Technical Machinery	2[1]
Engineering Laboratory	4
Strength and Stability of Structures; Theory of Elasticity	3
Forging and Metal Turning	5
Political Economy and Industrial History	1
Business Law	1
Thesis	—
Options.	
Organic Chemistry	3
Hydraulic Motors	2
Applied Chemistry (additional)	2[1]
Theoretical Chemistry	2

23. *Course in Sanitary Engineering.*—The Course in Sanitary Engineering is thus referred to in the "Catalogue":—

The Course is essentially one in civil engineering, but is designed for students who wish to pay particular attention to those engineering branches which are concerned with problems of the public health, and who, therefore, desire to gain a better knowledge of the subjects of chemistry and biology, and of their relations to engineering problems, than can be obtained in the Course in Civil Engineering.

The line of study offered differs from the regular Course in Civil Engineering in the following particulars:—

There is a reduction in the time devoted to railroads and bridges, and an entire omission of the mechanical engineering subjects of mechanism and steam engineering, and of astronomy and historical geology.

The time thus gained is devoted principally to courses in chemistry and biology. In these it is designed to give the students such training as shall fit them to interpret properly the results of researches in sanitary chemistry and sanitary biology, and to co-operate with chemists and biologists in professional work. Practice is given in the chemical and biological laboratories, and the student is instructed in the methods of water and air analysis, and is taught to observe and identify the various animal and vegetable organisms present in natural waters and sewage. The course devotes particular attention to the sanitary side of questions of water supply and drainage, and discusses, among other things, the principles of filtration and the methods of purifying water and sewage, the relation between drinking waters and disease, the methods of disposing of sewage, and other questions relating to the health of communities. In the fourth year, courses of instruction are given also in heating and ventilation and in hydraulic machinery.

The entire instruction in sanitary and hydraulic engineering now given in the Course in Civil Engineering, a portion of which is there optional, is required in the Course in Sanitary Engineering."

The details of the curriculum are outlined hereunder:—

SANITARY ENGINEERING. (XI.)

The *First Year* is identical with Course I.

SECOND YEAR.

First Term.	Hrs. per Week.
Surveying and Plotting	6
Topographical Drawing	2
Organic Chemistry (brief course)	1
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
Descriptive Geometry	5
German *or*	3
French	3
English Literature	1
European History	2

Second Term.	Hrs. per Week.
Surveying and Plotting	5
Qualitative Analysis (lectures and laboratory)	4
Biology, General	1
Dynamical Geology	3
Integral Calculus	3
Physics: Electricity, Optics (lectures)	5
German *or*	3
French	3
English Literature and Composition	2

THIRD YEAR.

First Term.	Hrs. per Week.
Railroad Engineering	2_{10}
Field-work and Drawing	2
Stereotomy	4
Advanced Surveying	2
Quantitative Analysis (lectures and laboratory)	3
Micro-Organisms	1
Structural Geology	2
Physics: Heat	2_{8}
Physical Laboratory	2_{7}
General Statics; Stresses in Frames; Strength of Materials	4_{20}
German *or*	3
French	3
Political Economy	2

Second Term.	Hrs. per Week.
Railroad Engineering	3_{7}
Highway Egineering	3_{5}
Field-work and Drawing	5
Advanced Surveying	2
Theory of Structures	2_{10}
General Bacteriology	4
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics; Theory of Elasticity	3_{10}
German *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1

FOURTH

1 Additional work optional.

FOURTH YEAR.

First Term.	Hrs. per Week.
Theory of Structure: Bridges and similar Structures	3
Hydraulics	3
Hydraulic Measurements	3[7]
Sanitary and Hydraulic Engineering	3
Bridge Design	4
Water Analysis	2
Bacteriology of Water and Sewage	2
Chemistry of Water and Sewage	1
Metallurgy of Iron	1
Industrial Electricity	1
Heating and Ventilation	2
Pipe-fitting	2

Second Term.	Hrs. per Week.
Theory of Structures: Bridges and similar Structures	3
Hydraulic Engineering	3
Hydraulic Machinery	2
Sanitary and Hydraulic Designs	6
Municipal Sanitation	2
Air Analysis	1
Sanitary Science and Public Health	1
Microscopic Analysis of Water and Sewage	2
Building Construction	1
Engineering Laboratory	2[8]
Thesis	—

24. *Course in Geology.*—The Course in Geology aims at giving :—

"A general education in natural science, with special training in geological work and studies. The occupations which its students may naturally have in view include employment in responsible positions upon local, State, or national surveys, and practice as professional geologists in any of the economic or technical relations of the science, or in connection with collegiate or other institutions.

"The demand for men who have united topographic with physiographic and geologic studies has been increased by the modern methods of conducting governmental and other surveys. That the students may be better prepared for such work, the amount of topographic, geodetic, and hydrographic surveying is larger than has been common in geological courses, The students are further qualified by the addition of physiographic geology and hydrography with field-practice, and by the construction of geologic maps and sections.

"Option 1 provides a training for those who may wish to apply geological science in connection with the examination or the development of any of the various mineral resources of a country. To the studies of chemistry and assaying they may add mining and metallurgy if they so elect, while the schedule of the course provides for economic geology and the study of ore-deposits.

"Option 2 of the course affords an opportunity to students to extend their studies in chemistry, to add comparative anatomy, and in the fourth year to work in experimental geology.

"Option 3 gives a larger proportion of time to topographic and other surveying studies, and is offered for the benefit of those who desire to be prepared for work in physiographic geology.

"It is recognised that some students, especially those who contemplate teaching, may for good reasons wish for a different selection of studies; for example, the substitution of natural history subjects for those in civil engineering. Applications for such substitution may be submitted to the Faculty."

The programme is developed as follows:—

GEOLOGY.—(Course XII.)

The First Year is identical with Course III.

SECOND YEAR.

First Term.	Hrs. per Week.
Physiography	2
Mineralogy and Blow-pipe Analysis	6
General Biology	5
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
German, *or*	3
French	3
English Literature	1
European History	2
Options.	
1, 2. Qualitative Analysis (lectures and laboratory)	8
3. { Surveying and Plotting	6
{ Topographical Drawing	2

Second Term.	Hrs. per Week.
Structural and Chemical Geology	4
Geological Field-work and Laboratory	3
Dynamical Geology	3
Zoology and Botany	3
Physics: Electricity, Optics (lectures)	5
German, *or*	3
French	3
English Literature and Composition	2
Options.	
1, 2. Quantitative Analysis (lectures and laboratory)	6
3. Surveying and Plotting	5

NOTE—Field-work in Mineralogy (Elective).

THIRD YEAR.

First Term.	Hrs. per Week.
Historical Geology	3
Geological Maps and Sections	2
Structural Palæontology	4
Geological Field-work	4
Anthropology	1
Physics: Heat	2[8]
Physical Laboratory	2[7]
German, *or*	3
French	3
Political Economy	2
Options.	
1. Quantitative Analysis (lectures and laboratory)	8
2. { Comparative Anatomy	2
{ Advanced Surveying	2
3. Experimental Geology	8

Second Term.	Hrs. per Week.
Mineralogy	4
Stratigraphic Palæontology	4
Glacial Geology	1
Assaying	2
Physical Laboratory	2
German, *or*	3
French	3
Political Economy and Industrial History	1
Business Law	1
Options.	
Quantitative Analysis (lectures and laboratory)	8
Theoretical Chemistry	2
Comparative Anatomy	2
Freehand Drawing	2
Advanced Surveying	2
Applied Geology	8

FOURTH

FOURTH YEAR.

First Term.	Hrs. per Week.
Physiographic Geology	3
Ore-deposits	2
Micro-Lithology	3
Geological Field-work and Laboratory ...	8
Geological Memoirs	1
Climatology	2
Stratigraphic Correlation	5
Options.	
1. { Mining Engineering and Metallurgy ...	4
{ Elements of Non-ferrous Metallurgy ...	2_{10}
2. Experimental Geology	6
3. { Mining Engineering	3
{ Hydraulic Measurements	3_7

Second Term.	Hrs. per Week.
Economic Geology	4
Micro-Lithology	3
Geological Field-work and Laboratory ...	10
Geological Memoirs	1
Hydrography	3
Thesis	—

25. *Course in Naval Architecture.*—The Course in Naval Architecture provides—

"A thorough training in the theory and methods of designing and building ships, together with a study of the properties requisite for safety and steadiness at sea. It aims to furnish a well-rounded preparation, appropriate for those who expect to enter the regular work of the profession as ship-builders, ship-designers, ship-managers, or marine engine builders. Like all the courses at the Institute, it gives, in addition to a professional and technical training, a good scientific and liberal education.

"In addition to the literary, mathematical, and general scientific studies requisite for a well-rounded education and for proper preparation for the special work of the course, thorough training is given in mechanism, thermodynamics, applied mechanics, hydraulics, steam engineering, and marine engineering. It is believed that the best co-ordination of the design of a steamship and its propelling machinery is attained by a naval constructor who is familiar with both branches of his profession.

"In the third year of the course, lectures are given on the methods of building ships of wood and of steel, on the general properties of floating bodies, on statical and dynamical stability of ships, and on such special problems as launching and docking. In the fourth year the lectures treat of the strength of ships, resistance and propulsion, the rolling of ships, the theory of oscillating waves and of waves of translation, and the steering and manœuvring of ships; also of ventilation and drainage and of adjustment of compasses. The lectures are accompanied by two or three exercises a week in drawing, in which the students make the calculations and constructions described in the lectures, and thus gain a proper appreciation of the principles learned and facility in applying them.

"The work in applied mechanics and steam engineering is accompanied by a full course in the laboratories of engineering and applied mechanics. Instruction is given in the mechanical laboratories, in forging, chipping, and filing, and machine-tool work."

There is a second course for "Naval Constructors," which will be dealt with in next section. The details of the course are as hereunder:—

NAVAL ARCHITECTURE (XIII).

The *First Year* is the same as that of Courses II, III (2), VI, VIII (3), and X.

SECOND YEAR.

First Term.	Hrs. per Week.
Principles of Mechanism	2
Drawing	2
Forging	4
Differential Calculus	3
Physics: Mechanics, Wave-motion, Electricity (lectures)	5
Descriptive Geometry...	5
German *or*	3
French	3
English Literature	1
European History	2

Second Term.	Hrs. per Week.
Mechanism: Gear-teeth; Machine-tools ...	2
Drawing	5
Forging	6_8
Chipping and Filing	6_7
Integral Calculus	3
Physics: Electricity, Optics (lectures) ...	5
German *or*	3
French	3
English Literature and Composition... ...	2

THIRD YEAR.

First Term.	Hrs. per Week.
Naval Architecture	2
Naval Architectural Drawing	6
Mechanism Design	2
Steam Engineering; Valve-gears; Thermo-dynamics	3
Elements of Differential Equations	2_5
Physics; Heat	2_8
Physical Laboratory	2_7
General Statics	2
German *or*	3
French	3
Political Economy	2

Second Term.	Hrs. per Week.
Naval Architecture	2
Naval Architectural Drawing...	5
Steam Engineering; Boilers	3
Engineering Laboratory	2
Physical Laboratory	2
Strength of Materials; Kinematics and Dynamics	3
German *or*	3
French	3
Political Economy and Industrial History ...	1
Business Law	1

FOURTH

FOURTH YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Naval Architecture	2	Naval Architecture	2
Naval Architectural Drawing...	4	Naval Architectural Drawing	6
Marine Engineering	3_{6}	Marine Engineering	3
Steam Engineering	2_{8}	Engineering Laboratory	4
Hydraulics	—	Strength and Stability of Structures; Theory of Elasticity	3
Engineering Laboratory	4	Machine-tool Work	6
Dynamics of Machines	3_{9}	Thesis	—
Strength of Materials; Friction	3		
Chipping and Filing	6_{5}		
Machine-tool Work	6_{10}		
Metallurgy of Iron	1		

26. *Course in Naval Architecture for Naval Constructors.*—In the Catalogue this subject is referred to in the following terms:—

"The Massachusetts Institute of Technology has been selected by the United States Naval Department to give professional instruction to officers designated for the corps of naval constructors. For the satisfactory completion of this course the degree of Master of Science is given.

"In arranging this course, the objects sought are the addition to the training already obtained at the Naval Academy of those subjects which are peculiar to naval architecture, and such an extension and rounding out of that training as will best enable a naval constructor to meet the varied and exacting demands of his official position. The course includes all the lectures and drawing of the regular four-year course, and one additional year of advanced work, having special reference to the military requirements of naval vessels. Other subjects selected from the regular course are marine engineering, steam engineering, and applied mechanics. The course is broadened and strengthened by courses on sanitation, heating and ventilation, foundations, metallurgy, and metallography. A thorough course is given in electrical engineering, with adequate training in physical and electrical engineering laboratories. Lectures and laboratory work are given on paints, oils, and other organic materials used on ships. Lectures will be given from time to time by naval constructors and other eminent specialists on subjects pertaining to the practice of ship-building.

"The first and second years of the following schedule of the Course for Naval Constructors correspond respectively to the third and fourth years of Course XIII; the third year corresponds to graduate work in other departments, and leads to the degree of Master of Science."

The special course is developed, as shewn in the following curriculum:—

NAVAL ARCHITECTURE (XIIIA).

Course for Naval Constructors

FIRST YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Naval Architecture	2	Naval Architecture	2
Naval Architectural Drawing...	6	Naval Architectural Drawing...	5
Mechanism	2	Advanced Calculus	1
Differential Equations...	3	Strength of Materials. Kinematics and Dynamics	3
Least Squares	2	Organic Chemistry	1
Machine Drawing	4	Physical Measurements (lectures)	1
Qualitative Analysis (lectures and laboratory)	10	Physical Laboratory	2
Spanish	2	Theoretical Electricity...	2
		Hydraulics	2_{7}
		Sanitation of Ships	1
		Spanish...	2

SECOND YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Naval Architecture	2	Naval Architecture	2
Naval Architectural Drawing	4	Naval Architectural Drawing...	6
Steam Engineering	3	Steam Engineering	3
Drawing...	2	Engineering Laboratory	2
Strength of Materials: Friction	3	Strength and Stability of Structures: Theory of Elasticity	3
Theoretical Electricity...	2_{8}	Periodic Currents	1_{7}
Heating and Ventilation	1	Electrical Measuring Instruments	2_{7}
Spanish	2	Physical Laboratory	2
Chipping and Filing	6_{5}	Spanish	2
Machine-tool Work	6_{10}	Machine-tool Work	6

THIRD

THIRD YEAR.

First Term.	Hrs. per Week.	*Second Term.*	Hrs. per Week.
Naval Architecture	2	Naval Architecture	2
Ship Design	8	Marine Engineering	3
Marine Engineering	3_6	Ship Design	8
Steam Engineering	2_8	Electrical Engineering	5
Dynamics of Machines	3_9	Electrical Engineering Laboratory	2
Engineering Laboratory	4	Foundations	2_5
Metallurgy of Iron	1	Engineering Laboratory	4
Metallography	—	Thesis	—
Theory of Structures	1_5		
Electrical Engineering	4		
Electrical Testing	5		
Electrical Measuring Instruments	2_{10}		
Periodic Currents	1		

27. *Requirements for Graduation : Bachelor of Science.*—The first degree is *Bachelor of Science* (in the course pursued), and is given for the satisfactory completion of any of the regular courses of study.

To be entitled to this degree, the student must have attended the Institute for not less than the year immediately preceding his graduation; he must have, in all cases, completed the prescribed studies and exercises of the *four* years, and must, in addition, pass final examinations, if required, on subjects relating particularly to his course. He must, moreover, prepare a *dissertation* on some subject included in his course of study; or an *account of some research* made by himself; or an *original report upon some machine, work of engineering, industrial works, mine or mineral survey ;* or an *original design*, accompanied by an explanatory memoir. This thesis, or design, must be approved by the Faculty,[1] and handed to its Secretary not later than the first annual examination.

An applicant for the degree of *Bachelor of Science, in two courses* at the same time, must have made application for such candidacy not later than 1st November next preceding his graduation, and such applications will be granted only in the case of students who have previously anticipated fourth-year subjects in one or both of the courses in question to such an extent that they have ample time for the work proposed.

No degree can be conferred until all dues to the Institute are discharged.

Students leaving the Institute of their own motion before graduation are entitled to receive a *statement of attendance* from the Secretary.

28. *Master of Science.*—The degree of *Master of Science* is awarded for proficiency in complete graduate courses of study of at least one year's duration. *Except in cases of unusual attainment, the applicant for the degree of Master of Science must have taken his first degree in science in some science school, college, or university of good standing;* and his attainments must in general be equivalent to those required for the corresponding Bachelor's degree of the Institute. The detailed requirements are as follows:—

"He must file with the Secretary, before being accepted as a candidate, a statement of his previous work and present attainments, and of the advanced work which he proposes to do at the Institute. The candidate, if a graduate of the Institute, may offer either more advanced work in his own department or undergraduate professional work of an allied department; but, in general, the subjects must not be all of the latter class, and the thesis must be of higher grade than is required for the Bachelor's degree. He must pursue his course of study continuously, under the direction and oversight of the Faculty, for at least one full school year after filing his application, exhibiting during that time ability to conduct original investigations, and passing creditable examinations at such times and on such subjects as may be designated, and must finally present an acceptable thesis.

"In connection with such an advanced course of study, it should be remembered that the continually increasing specialisation of the various engineering professions, and the upward tendency of the standards of professional attainment, render it difficulty, in a four-year course, to give much more than a thorough training in the student's chosen specialty. Hence it is frequently of great advantage to a graduate from one of the engineering courses to devote an additional year to the professional work of another closely related course, with or without reference to obtaining the Master's degree. For example, a student who has received a degree in Mechanical Engineering may, by devoting a year to the study of theoretical and practical electricity, complete the professional subjects of the course in Electrical Engineering ; a graduate in Chemical Engineering may do the same ; or a graduate in Electrical Engineering or Chemical Engineering, by a year of additional study, may complete the professional work of Mechanical Engineering. The student who completes such a double course has obtained a broader scientific and professional education, is enabled to investigate a given problem on more than a single side, and is thus more efficient and independent in engineering practice.

"A candidate for the Master's degree following a plan of this kind will not in general be required to complete all the prescribed studies of the second department ; for example, a graduate in Electrical Engineering desiring to spend an additional year in the Department of Mechanical Engineering may be excused from a certain amount of mechanic arts and drawing."

29. *Doctor of Philosophy.*—The degree of Doctor of Philosophy is conferred by the Institute of Technology. It certifies to "high attainment of a grade which qualifies the recipient as a scientific investigator and teacher, the course of study leading thereto being mainly one of experiment and research, accompanied by such studies as may serve to promote a broad and thorough knowledge of the science which the student has chosen for his specialty. The candidate must pursue his studies and researches, under the direction and oversight of the Faculty, for at least two school-years, furnishing from time to time such evidences of progress as the Faculty, may require. His attendance must be continuous, except in case of absence previously approved by the Faculty, for the purpose of conducting researches and investigations in the field.

He must present a thesis, embracing the results of an extended original investigation, and must pass such examinations as the Faculty may require."

30. *Other advanced Courses.*—Advanced courses may be taken in selected lines of study or research, without reference to degrees, and may be pursued by graduates of the Institute without preliminary examination. They may also be undertaken by graduates of other institutions, who satisfy the Faculty that they are qualified to take advantage of the proposed courses. The

[1] Theses are written on one side only of paper of good quality, 8 x 1½ inches in size, with an inch margin on the inner edge and a half-inch margin on the outer edges.

The following is an indication of the graduate courses in Mining Engineering and Metallurgy, in Chemistry, and in Electrical Engineering.

MINING ENGINEERING AND METALLURGY (III GR.).

Graduate Course.—(Option 1.)

First Term.	Hrs. per Week.
Mechanism[1]	2
Steam Engineering	3
Drawing	5
Electrical Measurements	2
Electrical Engineering (lectures)	2
Electrical Engineering (laboratory)	2
Option A.	
Surveying	2
Railroad Drawing and Field-work	4
Structures[2]	3
Ore-dressing (reading)	2
Option B.	
Electro-chemistry	2
Electro-chemical Laboratory	3
Metallography (lectures; laboratory)	7
Heat Measurement (laboratory)	2

Second Term.	Hrs. per Week.
Mechanism	2
Steam Engineering	3
Drawing	6
Option A.	
Surveying	2
Railroad Drawing and Field-work	5
Structures	3
Ore-dressing Laboratory; Thesis	12
Option B.	
Electro-metallurgy	1
Metallurgical and Chemical Laboratory; Thesis	—
Gas Analysis	1
Distillation of Fuels	2[3]
Forging	3

CHEMISTRY (V GR.).

Graduate Course.

First Term.	Hrs. per Week.
Advanced Organic Chemistry	1
Advanced Theoretical Chemistry	1
Chemical Research	—
Option A.	
Electrical Engineering (lectures)	2
Electrical Engineering (laboratory)	2
Mechanism	2
General Statics[3]	2
Descriptive Geometry *or*[4]	5
Steam Engineering [3] [4]	3
Drawing[3] [4]	3
Option B.	
Electro-chemistry (lectures)	2
Electro-chemistry (laboratory)	3
Kinetic Theory of Gases[3]	1
Differential Equations[3]	3
Least Squares[3]	2

Second Term.	Hrs. per Week.
Advanced Inorganic Chemistry	1
Qualitative Analysis of Rare Metals	9
Chemical Research	—
Option A.	
Advanced Industrial Chemistry	1
Mechanism	3
Drawing	3
Strength of Materials[3]	3
Steam Engineering[3] [4]	3
Drawing[3] [4]	2
Engineering Laboratory[3] [4]	2
Option B.	
Electricity	2
Polarised Light	1
Energetics[3]	2
Advanced Calculus[3]	1

ELECTRICAL ENGINEERING.—(VI GR.)

Graduate Course.

First Term.	Hrs. per Week.
Theoretical Electricity: Advanced Theory of Polyphase Transmission Lines	3
Laboratory of Electrical Measurements: Advanced Work in Electrical Testing	5
Laboratory of Electrical Engineering: Advanced Direct and Alternating Current Work	5
Design of Stations and Distribution Systems	5
Advanced Dynamo Design	1
Heat Measurements	4
Strength of Materials	—
Drawing and Machine Design	4
Electro-chemistry	2
Fourier's Series	2

Second Term.	Hrs. per Week.
Theoretical Electricity: Advanced Theory of Polyphase Transmission Lines	3
Laboratory of Electrical Engineering: Advanced Polyphase Work	5
Design of Stations and Distribution Systems	6
Specifications and Contracts	2
Machine Design	8
Fourier's Series	2
Thesis	—

31. *The Laboratory Equipments.*—The laboratory equipments of the Massachusetts Institute of Technology were very complete and extensive at the time of the Commissioner's visit, and the Institute is considered by European critics to be on a high plane of efficiency in regard thereto. It was visited by the Commissioner during their stay in Boston. The

[1] Descriptive Geometry must have been completed.
[2] The course in the Theory of Structures must have been completed.
[3] The courses in the Differential and Integral Calculus must have been taken.
[4] Students are required to satisfy the instructor in charge of this subject as to their preparation in Descriptive Geometry. Students who have not previously taken these preparation-subjects are advised to prepare themselves in them during the summer preceding their graduate course.

The following may be a sufficient general indication of its equipment:—

32. *Equipment for Mechanic Arts.*—In *Mechanic Arts* "the carpentry, wood-turning, and pattern-making departments contain forty carpenter's benches, two circular-saw benches, a swing-saw, two jig-saws, a buzz-planer, thirty-six wood-lathes, a large pattern-maker's lathe, and thirty-six pattern-maker's benches. The foundry contains a cupola furnace for melting iron, two brass furnaces, a core oven, and thirty-two moulder's benches. The forging department contains a power-hammer, thirty-two forges, seven blacksmith's vices, one blacksmith's hand-drill, and a power-shear. The machine department contains twenty-three engine-lathes and seventeen hand-lathes of approved patterns, a 24-inch turret-lathe, two machine-drills, three planers, a shaping-machine; two universal milling-machines, furnished with spiral and gear-cutting attachments; a universal grinding-machine, a cutter and reamer grinder; thirty-two vice-benches, arranged for instruction in vice-work; a 24-inch standard measuring-machine, special apparatus for hardening and tempering, and a fully-equipped tool-room."

33. *Equipment for teaching Chemistry.*—Chemistry has ordinary qualitative and quantitative laboratories for inorganic and organic chemistry, special physico-chemical equipment, an industrial laboratory, etc.

The *Kidder Laboratories* "afford accommodations for more than six hundred students. The Chemical Department occupies twenty-two laboratories, three lecture-rooms, a reading-room and library, two balance-rooms, offices, and supply-rooms; in all, forty rooms. Five new laboratories have been recently added for advanced work and research. The *laboratory for inorganic chemistry* has places for four hundred students, and is completely equipped for instruction in elementary chemistry. The analytical laboratories can accommodate one hundred and fifty students, and possess every convenience for accurate and rapid analytical work. The main *organic laboratory* has places for thirty-six students, and is provided with appliances for vacuum, steam, and fractional distillation, with suction pumps for filtration, with electrolysis circuits, filter-presses, etc. Adjoining it is a laboratory arranged for organic combustions, and on the roof is an enclosed room, in which chemical operations of a dangerous or noxious character can be performed. The laboratory of water, air, and food analysis contains places for sixteen students, and possesses a complete outfit for the analysis of air and water, and for the investigation of sanitary problems. The laboratories of industrial chemistry accommodate forty-eight students. They comprise a series of rooms in the Pierce Building, fitted with the needful apparatus for the preparation of chemicals on a considerable scale. The main laboratory contains kettles of various patterns, stills, presses, tanks, centrifugal dryers, crystal dryers, a filter-press, a furnace, and a variety of other forms of apparatus. The laboratory devoted to textile colouring contains numerous jacketed kettles, baths, and dye-tubs, squeeze-rolls, a steamer, an ager, and a dryer. The laboratory for oil and gas analysis accommodates thirty-six students and is equipped, for the examination of gases, with thirty-three sets of gas-absorption and explosion apparatus, with sampling apparatus, flue thermometers, a photometer, and a gas calorimeter. For the analysis of oils, the laboratory is provided with viscosimeters, testing machines, different sorts of flash-point apparatus, and other instruments employed in this special line of work. There are also special laboratories for instruction in proximate technical analysis, in molecular weight determinations, and in sugar analysis. *Kidder Hall* has a seating capacity of two hundred and twenty, and is arranged with special reference to the delivery of lectures illustrated by experiment. In addition, there are two lecture-rooms, seating respectively forty-eight and one hundred and twenty-five students. The lecture-rooms contain valuable cabinets of specimens for purposes of illustration. The balance-rooms are supplied with twenty-five analytical balances.

"The *William Ripley Nicholls Chemical Library*, numbering more than nine thousand volumes and fifteen hundred pamphlets, is kept in the reading-room of the department. This library, which is open to all students, contains *complete sets* of most of the important chemical periodicals and a noteworthy collection of works upon sanitary science. The number of periodicals currently received is one hundred and seventy-five."

34. *Equipment for teaching Physics.*—The *Rogers Laboratory* of Physics "occupies sixteen rooms. Of these, two are lecture-rooms: the general physical lecture-room, seating three hundred and fifty students, and a smaller lecture-room for special lectures in physics and chemistry, seating seventy. Both of these are fitted with appliances for physical experimentation and for the use of the lantern. The *laboratory of general physics* is devoted to instruction in general physical measurements. The *acoustic laboratory* is especially designed for acoustic and telephonic research, and the optical room for the study of light. *The laboratory of electrical measurements* is furnished with special electric circuits for lighting and power, and for both direct and alternating currents. The *laboratory of heat measurements* and the *laboratory of physical chemistry* are devoted to advanced work in these subjects. Several dark-rooms are appropriated to *photometry* and *photography*.

"The *Laboratories of Electrical Engineering* constitute a further important portion of the Rogers Laboratory. The dynamo-room contains a large plant of direct and alternating current machinery, the driving power for which is furnished by a Westinghouse 90-horse-power simple engine and a Westinghouse 130-horse-power compound engine. Several other rooms are fitted up for study and research in the various branches of technical electricity.

"The laboratory has an exceedingly extensive equipment of apparatus for both demonstration and physical measurements, and large additions are made to it every year. It is especially well furnished with instruments for electrical testing, and for heat, sound, and electro-chemical measurements.

"The library of the department contains over six thousand volumes, and is very complete in recent works upon physics and electricity. All new publications of importance are procured upon their issue. The principal physical and electro-technical periodicals are received regularly, *seventy-four* such being taken."

35. *Electrical Engineering Laboratory.*—The equipment of the Laboratory of Electrica Engineering "includes a large number of dynamo machines, both alternating and direct current, of various types and sizes, which are wholly available for purposes of instruction.

"Among these are the following:—An Edison shunt generator, having a capacity of 96 ampères at a pressure of 110 volts; a Thomson-Houston inclined-coil constant potential generator, having a capacity of 120 ampères at 110 volts; a Westinghouse multipolar compound generator, having a capacit

of

of 180 ampères at 110 volts; a United States direct current compound generator, having a capacity of 340 ampères at 110 volts; a Weston shunt generator, having a capacity of 60 ampères at 70 volts; a Thomson-Houston alternating current generator, having a capacity of 30 ampères at 1,000 volts, with transformers of various patterns and sizes up to 15 kilowatts; a Mordey inductor alternating current generator, having a capacity of 37 ampères at 1,000 volts; a Brush arc-light generator, having a capacity of 10 ampères at 1,500 volts; an experimental three-phase low-pressure alternating current generator, having a capacity of about 15 kilowatts at 500 volts; a Westinghouse shunt generator for electrolytic work, having a capacity of 300 ampères at 15 volts; a General Electric compound bipolar generator, having a capacity of 25 ampères at 125 volts; a Westinghouse 10-horse-power machine arranged for use as a 120-volt direct current generator or motor, a quarter-phase alternating current generator or motor, or a rotary transformer; a 220-volt 7½-horse-power Thomson-Houston shunt motor; a 7-horse-power 500-volt three-phase alternating current motor; several 15-horse-power 500-volt Thomson-Houston and Edison street-railway motors; and a large number of small direct and alternating current generators and motors of various sizes up to 5-horse-power. The laboratory possesses a 15-kilowatt Thomson welding-coil, furnishing current up to 3,000 ampères if required; a set of 10-kilowatt phasing transformers for use in connection with the three-phase and quarter-phase machines; and also a constant current transformer.

"A separate plant has been installed for use in regular laboratory instruction, in connection with the course in dynamo-testing and dynamo-electric measurements. It consists of two similar four-pole moderate speed 25-kilowatt direct current compound generators made by the General Electric Company. They are belt-driven from a Westinghouse compound engine fitted with indicators, and having a surface condenser discharging the condensed steam into weighing tanks.

"The switchboard is so designed that the dynamos can be put in series or parallel, or connected in any special manner called for by the requirements of particular methods of testing the efficiency, or studying the losses, either of the dynamos alone or of these in connection with the engine. A number of Weston illuminated dial ammeters and voltmeters of suitable ranges constitute a part of the equipment. They are provided with flexible lead-wires, and so arranged as to be readily connected to meet the requirements of the ordinary commercial methods of testing efficiency as well as those of the more refined electrical methods.

"The new lighting and power plant of the Institute in the buildings on Trinity-place is available for instruction and experiments related to central station work. In this plant there are two Westinghouse multipolar slow-speed direct current three-wire generators, each capable of giving a current of 350 ampères at 220 volts, or 350 amperes at 110 volts, on either side of the system. Each generator armature is carried by the extended shaft of 100-horse-power Westinghouse compound engine, running at a speed of 300 revolutions per minute."

36. *Equipment for instruction in Civil Engineering and Surveying.*—The instruction in Civil Engineering is given by means of lectures and recitations, and by practice in the field, in the drawing-room, and in the testing laboratory.

In surveying, besides the work in the class-room, the use of the various instruments is taught by actual work in the field, including the adjustments of the instruments and the principal operations involved in land, topographical, hydrographical, railroad, city, and underground surveying. The work in the drawing-room consists in representing upon paper the surveys made in the field, with practice in topographical and map drawing. The earlier field-work includes the use of the chain, tape, compass, transit, level, and solar compass, as well as of the various pocket instruments. This is followed by the use of the stadia, sextant, and plane table. The short course in practical astronomy includes a discussion of the methods of determining latitude, longitude, time, and azimuth, together with the theory of the usual astronomical instruments. The short course in geodesy includes a discussion of the figure of the earth, and of the methods of measuring base-lines and of carrying on a geodetic survey.

Students electing the geodetic option pursue these subjects in detail, taking also the course in the method of least squares, and receiving instruction in the adjustment of observations.

An observatory in the Middlesex Fells, within easy access of Boston, is devoted to instruction in geodesy and astronomy. It is a stone building 15 feet square, and contains at present the following apparatus: a transit instrument, 2½-inch aperture, 27-inch focus, with micrometer eye-piece for latitude observations; a sidereal chronometer, a chronograph, a magnetometer, a dip circle, an altazimuth instrument, and various other smaller appliances, such as level triers, mercury horizons, etc. This observatory enables the Institute to offer the best facilities for instruction in geodesy.

37. *The Hydraulic Laboratory.*—The Hydraulic Laboratory contains a closed steel tank 5 feet in diameter and over 27 feet high, arranged for the insertion of orifices, mouth-pieces, and other special pieces of apparatus, with gates for controlling the discharge, and with connections for supplying water, in experiments upon pipes and motors. This tank is connected with a 10-inch stand-pipe over 70 feet high, so arranged that a constant head may be maintained at any desired level. Two steel tanks, each of about 280 cubic feet capacity, give opportunity for the accurate measurement of larger quantities of water than can be weighed directly during experiments. A system of pipes connected both with the main tank and with the pumps is arranged for the insertion of diaphragms, branches, and other apparatus for studying loss of head and the laws of discharge. An attachment has been fitted to the main tank containing a Pitot tube for studying the laws of velocity in jets, and adjustable points for accurate measurement of the cross-section of jets.

The laboratory is further equipped with a 48-inch Pelton wheel of 30 horse-power; a 3-foot American impulse wheel; a Venturi meter; an 8-inch, a 12-inch, and two 48-inch weirs, and an orifice tank for measuring water; a centrifugal pump; a rotary pump; a plunger pump; a pulsometer; a 3-inch water-meter, and others of smaller size; and variety of mercury gauges, standard orifices, mouth-pieces, diaphragms, branches, nozzles, etc., for experiments with flowing water under all conditions. A 6-inch turbine is arranged to be run under various conditions of head and gate opening in tests for efficiency. There is also an hydraulic ram with a 2½-inch drive-pipe. The laboratory also contains a steel weir-box, the weir having a standard crest adjustable as to length from zero to 5 feet, and a seconds pendulum, with chronograph for exact determination of time in experimental work. Water is directly supplied for experiment by the various pumps.

38.

38. The *Steam Laboratory.*—The Steam Laboratory contains a triple-expansion engine, with cylinders of 9 inches, 16 inches, and 24 inches diameter respectively, and 30 inches stroke, arranged in such a way as to be run single, compound, or triple, as desired for purposes of experiment. This engine is of the Corliss type, and has a capacity of about 150 horse-power when running triple, with an initial pressure of 150 pounds in the high-pressure cylinder. It is connected with a surface condenser and the other apparatus necessary to adapt it to the purposes of accurate experiment. A tandem compound high-speed engine of about 225 horse-power, having cylinders 11 and 19 inches in diameter by 15 inches stroke, is similarly provided with surface condenser, air-pump, and other apparatus needed for testing. This engine transmits its power through a rope-drive.

This laboratory also contains a three-stage air compressor adapted to compress 100 pounds pressure per square inch, connected with storage tubes of about 58 cubic feet capacity; a 16-horse power engine, and an 8-horse-power engine, used for giving instruction in valve setting, etc.; also a 36-horse-power gas-engine and a small gas-engine. It is equipped with several surface condensers, steam-pumps, injectors and ejectors, calorimeters, mercurial pressure and vacuum columns; apparatus for determining the quantity of steam or air issuing from a given orifice or through a short tube under a given difference of pressure; apparatus for testing steam-engine indicators; apparatus for testing injectors; and indicators, planimeters, gauges, thermometers, anemometers, and other accessory apparatus.

The Engineering Laboratories are provided with a number of friction brakes; with machinery for determining the tension required in a belt or rope to enable it to carry a given power, at a given speed, with no more than a given amount of slip; with four transmission dynamometers; with two machines for determining the coefficient of friction of lubricating oils; with a pendulum governor arranged for experimental purposes; with a complete set of Westinghouse air-brake apparatus, including the parts belonging to the car and to the locomotive; with the pump and engineer's valve of the New York air-brake; with a locomotive link model; with two hot-air engines; and with cotton machinery as follows:—Two cards, a drawing-frame, a speeder, a fly-frame, a ring spinning-frame, and a mule, as well as accessory apparatus. There are available for purposes of experiment in connection with the work of these laboratories four horizontal tubular boilers in a boiler-house near the Engineering Building, with a wrought-iron stack 3 feet in diameter and 100 feet high, fitted with the apparatus necessary to make experiments on the draughts of chimneys; two large sectional boilers situated in the Rogers Building, with a masonry stack 3 feet square and 100 feet high; and also another boiler, a 40-horse-power engine, a number of looms, and other apparatus in the mechanical laboratories on Garrison-street.

39. *The John Cummings Laboratories of Mining Engineering and Metallurgy.*—These laboratories are designed "to furnish students the means for experimental study of the various processes of ore-dressing and smelting, and at the same time to give them the mental training needful for professional practice. The apparatus has been chosen with a view to illustrating, as far as possible, the principles of the more important machines and furnaces actually used in mines, mills, and smelting works.

"The crushing, concentration, and smelting of ores of lead, copper, gold, and silver furnish the best field for this laboratory work. The production of iron and steel in quantity is precluded by the size of the plant required, and by the large amount of ores and fluxes needed; the microscopical study of the structural changes that occur under heat treatment takes its place."

. . . .

"The laboratories include five parts: concentration and plate amalgamation, roasting and smelting, lixiviation and pan amalgamation, assaying, and heat treatment and microscopical examination of metals and alloys.

"In the concentrating laboratory the effects of different combinations and adjustments of machines upon the saving of losses in slimes and included grains, in order to produce the best scientific result or the greatest commercial profit, can be tested under the very best conditions. Among these combinations are graded crushing, graded sizing, graded jigging; hydraulic classifying as a preparation for jigging and the slime table; jigging with much or little suction; the variations of the slope, the quantity of water, and the roughness of the surfaces of slime tables; and the adjustments of the gravity stamps, the amalgamated plates, and the Frue vanner.

"In the lixiviating and amalgamating laboratory, the effects of varying the sizes of grains, the strength of the cyanide solution, and the time of treatment may be tried; suitable variations also may be made in the hyposulphite process, and either by vat or by revolving barrel, in the chlorination process; in the amalgamating pan the temperature, the chemicals, and the time of exposure can all be studied for the production of the best results.

"The smelting laboratory is provided with furnaces for roasting, smelting, and refining copper; for roasting, smelting, and cupelling lead; and for 'chloridizing' roasting preparatory to pan amalgamation or lixiviation. The smelting of a ton or two of ore cannot in the nature of things produce results which approach as nearly to the economy of practice on a large scale as is done in the other experimental lines, but the experience which the students gain throws more light upon the meaning of the lectures than any other work performed in these laboratories.

"The assaying laboratory is provided with furnaces for crucible work, scorification, cupellation, and all the usual accompanying operations. Near by are rooms for fine balances and for supplies. This laboratory not only provides for the regular course in assaying which is taken by all the students in Mining Engineering and Chemistry, but it furnishes a means of testing and checking the work of the other three laboratories. A laboratory with chemical desks is provided, for connecting all the small lixiviation tests and such wet work as is necessary in connection with the smelting and lixiviation of ores. The blowpipe laboratory of the Geological Department is used for the blowpipe silver assay.

"The Metallographical Laboratory is furnished with the necessary apparatus for heating, grinding, and polishing specimens of metals and alloys, for examining them microscopically, and for taking micrographs.

"A museum of ores, products, and models of mining engineering and metallurgy serves to illustrate the lectures."

40. *Biology.*—For instruction in biology, the Institute now affords "unusual opportunities for advanced or special work in fermentation, hygiene, and sanitary science. The departments giving the principal instruction in these subjects are those of biology, chemistry, physics, architecture, and sanitary engineering. Graduate or special superintendents of water-works or sewer departments, or persons engaged in industries depending on the activities of yeast, bacteria, etc., if qualified to pursue their work with advantage, will be admitted to such subjects as they may elect, and will be given every opportunity to equip themselves for their work."

The *Biological Laboratories* "comprise four well-equipped laboratories for undergraduates, with smaller rooms for special lines of work, and a laboratory devoted to more advanced or special investigation. In connection with these there is a well-appointed library and reading-room, centrally placed, and containing more than two thousand volumes.

"A large laboratory of general biology and microscopy supplies the needs of classes in these subjects, as well as those in elementary zoology and botany. It is furnished with microscopes, microscope lamps, suitable work-tables, and other appliances. The proximity of Boston to the sea offers exceptional facilities for work along these lines, as well as for the more advanced study of zoology and botany.

"A second laboratory, somewhat smaller, furnishes opportunities for the practical work of the classes in comparative anatomy, embryology, cryptogamic botany, and histology. It is equipped with Thoma and Minot microtomes, paraffin baths, microscopes, and reagents for work in the gross and microscopic anatomy of plants and animals. Students of biology have also valuable privileges in connection with the Boston Society of Natural History, of which the museum and library are freely accessible.

"For experimental work in physiology there is a special laboratory, equipped with continuous roll and drum kymographs, induction coils, and other electrical apparatus, moist chambers, tambours, plethysphygmographs, etc., for physiological measurements, and with desks for work in physiological chemistry. Adjoining this is a workshop, with lathe and tools, as well as a dark-room for work in physiological optics.

"The laboratory of bacteriology, industrial and sanitary biology, is supplied with the microscopes, incubating chambers, thermostats, and other special appliances necessary for the detailed and practical study of micro-organisms. In connection with it there is a special culture-room, and a room for chemical work and the preparation of nutrient media.

"Finally, there is a research laboratory for the use of graduate students and special investigators. This is fitted with thermostats, autoclaves, and other apparatus for the study of problems connected with the sanitary and industrial applications of biology.

"This whole series of laboratories is well organised for work, directed chiefly toward the microscopical, hygienic, and industrial side of biology, and offers special opportunities for those desiring to fit themselves for teaching or medical study, or for practical work in the biological sciences."

41. *Geology and Mineralogy.*—"The work of the department is introduced by courses in mineralogy and blowpipe analysis. Crystallography is taught with the aid of models, diagrams, and a series of crystals. In mineralogy, specimens are freely used, an example of each of the more important species being placed before each student, while a collection of typical specimens is always accessible. The students are taught to identify minerals by their crystallisation and physical properties, as well as by blowpipe or chemical tests. The instruction in blowpipe analysis is supplemented by sufficient practice to insure familiarity with the methods."

. . . .

"The laboratory of mineralogy is so equipped as to be convenient both as a class-room and as a laboratory for descriptive and determinative mineralogy. It contains collections of minerals arranged for class-work in each of the above subjects, and for the use of students in descriptive mineralogy. The tables in this room have been specially designed for the purpose of practice in blowpipe analysis. Here is also placed a machine for the cutting and polishing of mineral and rock sections."

42. *Conclusion.*—The general regimé of the Institute reminds one of German rather than of English traditions, students being judged more by their scientific and practical efficiency and thoroughness than by mere ability to pass written examinations.[1] This may be said to be characteristic also of the better class of American institutions. The Institute has a high reputation in Europe, and is one of the most thoroughly equipped.

There will be no difficulty in realising that such institutions as the Massachusetts Institute of Technology afford an opportunity of technical education that does not yet exist in Australia.

---

[1] It may be explained that the attitude to examinations in Germany and England is very different. The leaving examination at secondary schools, qualifying for the University, is very severe, but is *not* a "cram" examination. Students are judged afterward by their actual work. Original power of research, etc., wins distinction for a student in Germany. In the English system a good memory goes for more than original power.

CHAPTER XXXVII.

CHAPTER XXXVII.

The Stevens Institute of Technology, Hoboken, New Jersey.

[G. H. KNIBBS.]

1. *Introductory.*—The following brief account of the Stevens Institute of Technology, at Hoboken, New Jersey, should be read in comparison with the account of the Massachusetts Institute. It will be seen that the title of the American schools does not imply identity of organisation. The Stevens Institute is essentially a school of mechanical engineering, and confers upon its regular graduates the degree of "Mechanical Engineer"; its scope, therefore, is more limited than that of the Massachusetts Institute.

The Institute is finely housed and excellently equipped in regard to apparatus; and, judging by the entrance-examination papers, it insists upon a fair preparation in respect of arithmetic, algebra, geometry, trigonometry, physics, chemistry, English, and history.

It is the oldest school of importance in America for instruction in mechanical engineering, and was for a long time the *only* school of that character of any consequence in the United States. Until quite recently it has adhered exclusively to this one course, with the exception of a course in Electro-technics, which is regarded as merely a branch of mechanical engineering. The school has won distinction and has served as a model for other schools, though now outrivalled by the newer and better equipped Institutes of Boston and Ithaca (Cornell).

It was founded by Mr. Edwin A. Stevens in 1867, and its President, Henry Morton, Mrs. E. A. Stevens, and Mr. Andrew Carnegie have given large contributions toward its maintenance.

The plan of instruction pursued is said to be such as "will best fit young men of ability for positions of usefulness in the department of Mechanical Engineering, and in those scientific pursuits from which this and all the allied arts are daily deriving such incalculable benefits." With this object in view, a thorough training is given in all those branches of instruction appertaining to engineering science, such as the principles of mathematics, machine construction, mechanical drawing, manual exercises in shop practice, practical course in physics, the laboratory work of which has a direct bearing on engineering problems, and is consequently called engineering physics; a course of chemistry, analytical chemistry, both qualitative and quantitative, the French (or Spanish) and German languages, English literature and logic, and applied electricity.

To further the aim of the Institute there is a Library, containing about 6,000 volumes, "composed entirely of scientific and mechanical journals, transactions of societies, and other technical works, to which the students have access, under such restrictions only as are necessary for the proper care of the books."

2. *Admission.*—The conditions of admission are that the student be not under 17 years of age, and that he undergo an entrance examination in mathematics, descriptive geometry, trigonometry, geometrical drawing, English grammar and composition, and general history, rhetoric, physics, chemistry, and French.

The full course occupies a period of four years, each year being divided into three regular terms. Two classes, have a Supplementary Term of one month in addition, during which eight hours per day are devoted to Shop-work and Experimental Mechanics.

There is a Freshman, a Sophomore, a Junior, and a Senior Class, each of which is a year's duration.

3. *Departments.*—In the organisation of the Institute it is divided into the following departments, viz.:—

(1) Mathematics and Mechanics;
(2) Mechanical Drawing;
(3) Chemistry;
(4) Engineering;
(5) Testing;
(6) Experimental Mechanics and Engineering Physics.

Since the combination of, for example, mathematics and mechanics, as constituting a department, may be regarded as unusual, the following indication of the view taken by the Institute will be of interest:—*Mathematics and mechanics* are taught in close connection, because, it is said, the former has its foundation in the mechanics of nature.

To this end trigonometry is practically applied to such engineering problems as emphasise important formulæ and methods. A number of problems are executed with special reference to system and accuracy in obtaining data and calculating results, and to practice in the use of logarithmic and other tables. These problems also give the students practice in the use of a variety of engineering instruments and processes.

Analytical geometry and the infinitesimal calculus are taught in close connection by modern methods, and illustrated by problems in mechanics, electricity, etc.

The same is true of the complex variable and differential equations.

In order that the future engineer may be thoroughly grounded in the fundamental facts and principles of mechanics, the subject is taught so as to refer all questions and problems to them rather than to secondary formulæ based upon them. The subject is taught by a text-book, supplemented by lectures, and, in addition to blackboard recitations, the students are required to work out in permanent form a considerable variety of problems contrived to explain and emphasize important questions.

The elements of various branches of higher mathematics are introduced into the course as far as time permits.

A thoroughly mathematical treatment of the stresses in framed structures is given by a new method, admitting of perfectly general application, with accurate results.

A course of illustrated lectures is given on the mechanics of engineering instruments and other instruments of precision, in which their geometrical and mechanical features are discussed and their correct use in accordance therewith is taught.

In the *Department of Mechanical Drawing*, the aim is to make the work, as far as possible, to follow the lines of that of a practical draughtsman. The course is divided into eight sections, as follows:—

1. Progressive exercises in line work, consisting of the construction of geometrical diagrams, arranged with a view to securing facility and accuracy in the use of instruments.
2. Exercises in elementary projections—that is, in the representation of simple objects in various positions, in the manner universally employed in making drawings for practical purposes.
3. The application of what precedes, in making working sketches of mechanical details, with dimensions taken from measurements, and laying out actual working plans from these sketches.
4. The study of the elements of descriptive geometry, with application to shades, shadows and perspective.
5. The study of kinematics, or the analysis of mechanical movements.
6. The study of slide valves, valve diagrams and valve gears.
7. Practice in engine design.
8. The study of working drawings from which engines and machinery have been constructed.

In the *Department of Chemistry*, the study is taken up at the beginning of the first year by instruction in the subject of chemical physics, in the law of chemical combination, and in the principles involved in the determination of atomic and molecular weights. This is followed by the study of chemical notation and nomenclature, with practice in stoichiometry. Afterward the subject of chemical structure is taken up, along with an examination of the chemical and physical properties of bodies, as far as is involved in their identification and chemical classification.

Qualitative analysis is studied during the second year by the usual laboratory practice, and each student must give satisfactory evidence of his ability to make a thorough qualitative analysis of the more commonly occurring technical products before advancement to quantitative analysis.

The second year is also occupied with the subject of fuels, their composition, preparation, and calorific powers gases for illuminating and heating. Then the fluxes, minerals, and ores used in iron, copper, lead, zinc and tin smelting. The properties of the metals commonly used and the influence of impurities upon their strength and durability are studied so far as the practical needs of the engineer are concerned. Finally the description and management of furnaces, together with the chemical phænomena of smelting and extraction of ores.

In the third year, after the preliminary work in quantitative analysis, the determination of the percentages of the principal ingredients in the following substances comprises the regular exercises, but where the student will have a special line of work to pursue, after graduation, in which analytical chemistry forms a portion of his duties, the list is varied for the purpose desired.

In the *Department of Engineering*, the main purpose is to instruct the student in the scientific principles which control the power-producing capacity and economy of prime movers; or machines for driving other machines, by means of motive power supplied by muscular strength, the motion of water or wind, or by the mechanical action of heat.

The subjects discussed in the Junior year are: The powers of men and animals, the measurement of water power, and the laws of the flow of water in conduits, the principles of the action of water-wheels, turbines, and wind-mills, the laws of heat controlling the action of the heating surface of boilers, the laws of combustion, and the general theory of the efficiency of steam boiler furnaces.

The Senior year is devoted to the study of the general principles of thermo-dynamics and their application to the determination of the theoretical efficiency of air compressors, air, gas, oil, steam and volatile vapour engines, and refrigerating machines.

The shop-work is as follows:—

	Hours.		Hours.
Metal Lathe	80	Moulding	40
Pattern-making	36	Steam Fitting	18
Metal Planer	48	Wood Turning	40
Vice Work	18	Blacksmithing	40
Carpentry	40	Milling Machine	18
Brass Turning	24	Drill Press	18
Management of Steam Boilers and Ratchet Drilling	21	Millwrighting	20

The inspection tours are extensive, and frequently extend over ten days.

The *Department of Tests* has been organised to undertake measurements of the performance of steam engines and other motors, and of the efficiency of boilers, refrigerating machines, and mechanism generally, including electrical and hydraulic apparatus, also to make tests of strength of materials, and various chemical and physical investigations, for the general public.

The *Department of Experimental Mechanics and Engineering Physics* is distributed over two floors, the lower floor being devoted to the heavy machinery and apparatus for the course in experimental chemistry, etc., the lighter machinery and apparatus, such as that for testing the strength of materials, calibrating instruments, etc., is on the second floor. This latter consists of combustion calorimeters, such as the Mahler, for determining the heat of combustion of coal, and the Junker for determining the heat of combustion of gas; pyrometers, such as the Uehling, the Le Chatelier, and the Brown expansion, air thermometers; calorimeters to determine the dryness of steam and the latent heat of vapours; and apparatus for determining various physical constants. 4.

4. *Graduation Course.*—The details of a course leading to graduation are as follows :—

PROGRAMME OF COURSE IN THE STEVENS INSTITUTE OF TECHNOLOGY.

First Year (Freshman).

First Term :—

Mathematics.—Logarithms and Plane Trigonometry reviewed, Practical Engineering Exercises, Spherical Trigonometry.
Mechanical Drawing.—Elementary Projections.
Languages.—French or Spanish.
General Physics.—Sound.
Chemistry.—Inorganic ; Theoretical and General.
English Literature and Logic.—Meiklejohn's History of the English Language ; Lectures ; Essays.
Shop Work.

Second Term :—

Mathematics.—Theory of Equations, Complex Quantities, Analytical Geometry and Calculus.
Mechanical Drawing.—Elementary Projections, Freehand Sketching.
Languages.—French or Spanish.
General Physics.—Light.
Chemistry.—Inorganic ; Theoretical and General.
English Literature and Logic.—English Literature ; Essays.
Shop Work.

Third Term :—

Mathematics.—Analytical Geometry and Calculus, Practical Exercises.
Mechanical Drawing.—Elementary Projections, Freehand Sketching, Descriptive Geometry.
Languages.—French or Spanish.
Chemistry.—Inorganic ; Theoretical and General.
General Physics.—Light.
English Literature and Logic.—English Literature ; Essays.
Shop Work.

Supplementary Term :—

Shop Work.

Second Year (Sophomore).

First Term :—

Mathematics.—Analytical Geometry and Calculus.
Mechanical Drawing.—Machine Drawing from Sketches ; Descriptive Geometry.
Languages.—French or Spanish (concluded) ; German.
General Physics.—Heat ; Electricity.
English Literature and Logic.—English Literature ; Essays.
Chemistry.—Qualitative Analysis ; Laboratory Practice ; Chemistry of Engineering Materials ; Sexton
Shop Work.

Second Term :—

Mathematics.—Solid Analytical Geometry and Integral Calculus.
Mechanical Drawing.—Machine Drawing from Sketches ; Descriptive Geometry.
Languages.—German.
General Physics.—Heat ; Electricity.
English Literature and Logic.—Deductive Logic ; Essays.
Chemistry.—Qualitative Analysis ; Laboratory Practice ; Chemistry of Engineering Materials ; Sexton.
Shop Work.

Third Term :—

Mathematics.—Applications of the Calculus.
Mechanical Drawing.—Machine Drawing from Sketches ; Descriptive Geometry.
Languages.—German.
General Physics.—Heat ; Electricity.
English Literature and Logic.—Inductive Logic ; Essays.
Chemistry.—Qualitative Analysis ; Laboratory Practice ; Chemistry of Engineering Materials ; Sexton.
Shop Work.

Third Year (Junior).

First Term :—

Mathematics.—Analytical Mechanics ; Complex Variable.
Mechanical Drawing.—Kinematics, Machine Drawing and Design ; Valves and Valve Diagrams.
Language.—German.
Chemistry.—Quantitative Analysis ; Laboratory Practice.
Experimental Mechanics.—Indicators, Planimeters ; Experimental Exercises.
Applied Electricity.—Electrical Measurements.

Second Term :—

Mathematics.—Analytical Mechanics ; Differential Equations.
Mechanical Drawing.—Kinematics, Machine Drawing and Design ; Valves and Valve Gears.
Languages.—German.
Chemistry.—Quantitative Analysis ; Laboratory Practice.
Engineering.—Hydraulics, Water Wheels, Turbines and Wind-mills.
Experimental Mechanics.—Applied Mechanics of Machine Design ; Strength of Materials ; Experimental Exercises.
Applied Electricity.—Direct Current Machinery.

Third Term :—

Mathematics.—Analytical Mechanics.
Mechanical Drawing.—Kinematics ; Machine Drawing and Design ; Valves and Valve Gears.
Languages.—German (concluded).
Chemistry.—Quantitative Analysis ; Laboratory Practice.
Engineering.—Principles of Heat Controlling the Design and Performance of Steam Boilers.
Experimental Mechanics.—Applied Mechanics of Machine Design ; Practice in Designing Steel Construction Work ; Experimental Exercises ; Apparatus Lectures on Measurements of Resistance of Materials.
Applied Electricity.—Direct Current Machinery ; Lectures on Dynamo Design.

Supplementary Term :—

Experimental Mechanics.

Fourth

Fourth Year (Senior)

First Term :—

Engineering.—Thermo-dynamics.
Mathematics.—Construction, Adjustment and Use of Engineering Instruments; Graphical Statics; Problems in Applied Mechanics.
Mechanical Drawing.—Machine Drawing and Design; Lectures and Exercises in Applied Kinematics; Study in Actual Working Drawings.
Experimental Mechanics.—Applied Mechanics of Machine Design; Determination of Accelerative Forces in a Steam Engine and of Pressure Exerted on the Crank Pin; Proportion of Cylinder and Indicator Diagrams for Compound and Triple Expansion Engines.
Engineering Physics.—Laboratory Work.
Applied Electricity.—Alternating Currents and Alternating Current Machinery; Lectures and Laboratory Work.

Second Term :—

Engineering.—Heat Engines, Refrigerating Machines; Mechanics of Marine Architecture and Propulsion of Steamships; Lectures on Practical Engineering.
Mathematics.—Theory of Bridges and Roofs, with Graphical Statics applied; Selected problems; Least Squares.
Mechanical Drawing.—Machine Drawing and Design; Lectures and Exercises in Applied Kinematics; Study in Actual Working Drawings.
Experimental Mechanics.—Applied Mechanics of Machine Design; Graphical Solution of the Efficiency of Mechanisms.
Engineering Physics.—Laboratory Work.
Applied Electricity.—Alternating Currents and Alternating Current Machinery; Lectures and Laboratory Work.

Third Term :—

Work on Graduating Theses.

5. *Degree, Fees, Scholarship.*—The Degree of Mechanical Engineer is conferred when "due evidence of efficiency has been afforded in the final examinations and upon the presentation of theses."

The fees for each year of the entire course, for instruction and the use of instruments, are $150 (roughly, £30) for students at the time residing in the State of New Jersey. Those not so residing are charged $75 extra.

Scholarships are awarded by the Institute, which confer "the privilege of attending the entire course of the Institute for four years, free of all charge for tuition, provided, of course, the student holding the scholarship keeps up in all cases with the standard of proficiency and good conduct required."

6. *Examples of Practical and Theoretical work.*—A few examples illustrating how the subjects are treated will reveal the type of work aimed at in the Institute. For example, the course in Experimental Mechanics includes experimental work of the following type, viz. :—

Experiments to shew laws of friction. Coefficient of friction shewn to be equal to the tangent of the angle of repose.
Determination of the coefficient of friction of a journal for various pressures, and comparison with Morin's laws for a restricted feed of oil.
Determination of the friction of engines by means of different forms of prony brakes and indicators.
Tests of indicator springs at pressures above and below the atmosphere, and computations of the proper scale to use for a given diagram.
Valve setting. Ordinary slide valve set by each student.
Exercise with Corliss and Buckeye valve gears.
Experiments to shew the position of the valve of a steam engine corresponding to each point in the indicator diagram.
Experiments to shew the variation of indicator diagrams for various angles of advance of the eccentric.
Practice with planimeter and averaging instruments.
Experiments to shew the strength and elastic properties of timber under transverse stress. Tests of timber by comparison.
Determination of the horse-power transmitted by a belt and coefficient of friction for different amounts of slip, and a comparison of the results with ordinary horse-power formulæ.
Experiments with belting running upon flat and crowned pulleys on shafts in various positions.
Determination of the efficiency of rope, worm wheel and differential hoists.
Determination of the efficiency of an ordinary screw-jack, of a screw bearing on its end and of a screw with the load attached directly to it, with calculations of the coefficient of friction.
Determination of the centrifugal tension in a high speed belt.
Determination of tensile strength of metals and coefficient of elasticity.
Transverse test of a cast-iron bar, with tension and compression tests of the same material for comparison therewith.
Determination of the bursting strength of a steel tube and tensile tests of material cut therefrom.
Determination of the strength of gear-wheels in action.
Experiments with a special apparatus for recording the forces which overcome the inertia of the piston of an engine.
Experiments to shew the effect of counterweights on the shaking of an engine.
Experiments to shew the effect of compression on the running of an engine.
Determination of the radius of gyration of a connecting-rod by means of the torsion balance and by swinging it from its ends.

The courses in Engineering Physics include such experiments as the following :—

Determination of the specific heat of solids. Correction for radiation made by Regnault's method.
Determination of the specific heat of liquids. Correction for radiation made by Pfaundler's method.
Practice in the use of the microscope: determination of the magnifying power with several object glasses. Measurement of minute objects by means of micrometer scale and movable cross-hair.
Determination of the density of liquids with specific gravity flask and with hydrometer, all corrections being made and density corrected to the standard temperatures.
Determination of the expansion of liquids by heat, with curves of the law of expansion.
Determination of the specific gravity of solids.

Graduation

Graduation of a scale with the dividing engine.
Tests of thermometers.
Determination of the radiation of heat, from vessels exposed to the air, and comparison of the rate of cooling with Newton's law.
Determination of the heat of combustion of gases with the Junker calorimeter.
Practice in the use of an air thermometer; calibrations made by placing the bulb in broken ice and in steam at atmospheric pressure.
Determination of the coefficient of expansion of metals.
Determination with the saccharimeter of the percentage of cane sugar in crude samples, and other similar experiments.
Determination of the errors of standard scales and gauges by means of Rogers' comparator.
Determination of the moisture in air with the Regnault hygrometer, wet and dry bulb thermometers, and by direct weighing.
Determination of latent heats.
Micro-structure of a number of samples of steel treated by annealing and by quenching at temperatures above and below the critical points.
Determination of the critical points in steel by means of a Le Chatelier pyrometer.
Determination of the density of air and of illuminating gas, the compensating bulb of Regnault being used, and comparison with the density computed from the velocity of flow through an orifice.
Determination of the heat of combustion of coal with the Berthelot-Mahler calorimeter.
Determination of the boiling points of water at pressures lower than the atmosphere, and comparison with the results of Regnault's experiments.
Comparison of the Uehling, Brown expansion, and Le Chatelier pyrometers.
Photometrical measurements. Determination of the candle-power of illuminating gas, etc. Use of the Harcourt and the Dibdin Pentance Standards.

In the course in Applied Electricity the following series of experiments are made:—

1. Resistance measurements by Wheatsone's Bridge.
2. Conductivity of samples of wire.
3. Internal resistance of batteries.
4. Resistance by fall of potential.
5. Drop in a lighting circuit.
6. Determination of the horizontal component of the earth's magnetism.
7. Practice with differential galvanometer.
8. Capacity of condensers and cables.
9. Dynamometer constant by copper deposit.
10. Practice with ammeters and voltmeters.
11. Absorption of power by water rheostat.
12. Permeability curves of iron and steel.
13. Hysteresis curves of iron and steel.
14. Resistance temperature coefficients.
15. Calibration of ammeters by potentiometer method.
16. Calibration of voltmeter by potentiometer method.
17. Test of fuse wires.
18. Distribution of potential around commutator
19. Study and test of a shunt motor.
20. Leakage coefficient of a dynamo.
21. Practice in armature winding.
22. Study and test of an arc lamp.
23. Characteristic of a series dynamo.
24. Coupling dynamos on one circuit.
25. Practice with a 500-volt railway motor.
26. Study and test of a shunt dynamo.
27. Grounds and insulation resistance in lighting circuits.
28. Experimental study of transformers.
29. Efficiency test of a static transformer.
30. Measurement of inductance by secohmmeter.
31. Resistance, inductance, and capacity in an alternating current circuit.
32. Study and test of a rotary converter.
33. Efficiency test of a two-phase induction motor.
34. Practice with three phase alternating currents.
35. Test for efficiency and for power factor of a three-phase induction motor.
36. Tracing alternating current curves.
37. Efficiency test of a synchronous single-phase motor.
38. Efficiency test of a pair of similar dynamos by Hopkinson's method.
39. Study and test of a Thomson integrating wattmeter.
40. Study and test of phase-changing transformers.

7. *Apparatus Equipment.*—The Institute has been the recipient of a great many gifts, among which may be mentioned the following, viz.:—

Cross-compound Allis Engine of 70 horse-power, fitted with a Wheeler surface condenser and a vacuum pump.
Metal Testing Machine having a capacity of 100,000 pounds. (This was a gift of the Engineering class of 1901.)
Cahall Boiler, horizontal sectional water tube, of 125 horse-power, designed for a working pressure of 225 pounds.
Horizontal Tubular Boiler of 150 horse-power, made by Samuel Smith and Sons, of Paterson, N.J., designed for a working pressure of 125 pounds; it was the gift of President Morton, the head of the Institution.

Otto

Otto Gas Engine, 5 horse-power, the gift of a pupil of the 1898 class.
Burnham Steam Pump for supplying water to the 150 horse-power boiler at pressure of 225 pounds.
Metropolitan Injector for 150 horse-power boiler.
Standard Lundell Bipolar Motor, 5 horse-power.
Forbes Engine, compound high-speed, direct connected to 22-kilowatt Sprague generator; the joint gift of the class of 1902 and W. D. Forbes & Co.
Steam Jet Blower for 150 horse-power boiler.
Cochrane Feed Water Heater, special feed water expansion and return tank, with oil separator, for 300 boiler horse-power.
Cochrane Separator for 4-inch steam main.
Compound High Speed Engine, of 20 horse-power, of the marine type.
No. 7 Monitor Lifting Injector.
Sturtevant Blower for producing forced blast for boilers of 300 horse-power, the vertical slide-valve engine of 3 horse-power, and the Steam Pump, direct acting duplex, were the gifts of President Morton to the Institution.
Piping and Fittings for Sturtevant Blower for producing forced blast for boilers.
Ammonia Compression Ice-making and Refrigerating Plant, of 3 tons capacity; and the
Recording Pressure Gauge and a Recording Voltmeter.

These generous gifts of manufacturing firms are a happy augury for the development of technical education in America.

The equipment of the Electrical Workshop and Laboratory include the following:—

Direct-current machines of high and low voltage, shunt, series, and compound wound; one 650-light Westinghouse alternator, two 5-kilowatt La Roche alternators, and one 20-light high frequency alternator, built at the Institute; one 7½-kilowatt Westinghouse two-phase rotary converter; one 10-kilowatt Crocker-Wheeler motor-generator; one general electric three-phase induction motor; one Stanley-Kelly two-phase induction motor; one three-phase generator; one special polyphase generator, designed and built by the Department, giving single, two, and three phase alternating currents, and provided with revolving contacts for tracing curves. There is also a number of smaller machines, a bank of transformers, and a battery of storage cells.

Power is supplied by means of a 25-horse-power high-speed Payne engine and by motors connected to the 500-volt direct current and to the 2,000-volt two-phase alternating current supply from the central station of the city.

The steam engine and the rotary converter were presented to the Electrical Department by the class of 1895; the two-phase induction motor was presented by the class of 1896; the gas engine, with connected multipolar Riker dynamo, was presented by the class of 1897, aided by subscriptions from the Trustees and Faculty of the Institute; the two 5-kilowatt alternators were presented by the class of 1899; and the 7½-kilowatt induction motor, together with two 4-kilowatt phase-changing transformers, were presented by the class of 1900.

In the centre of the east wall of the dynamo room is a large switchboard, by means of which convenient connections can be made to the dynamos, lecture room, and laboratory tables. The Electrical Laboratory is well supplied with a great variety of commercial and laboratory measuring instruments. Among these are voltmeters, ammeters, wattmeters, electro-dynamometers, and one Kelvin balance (presented by the class of 1886); also tangent and ballistic galvanometers, electrometers. Also certified standards of resistance, inductance and capacity. There is in addition a number of models for lecture purposes.

8. *Concluding Remarks.*—The Stevens Institute, it will be seen, while liberal in its scheme of instruction, strongly accentuates the practical side of training. The type of work being done at the time of the Commissioners' visit, both in the experimental field and in the field of research, strongly emphasized the recognition of the fact that the educational value of the Institution was very high.

CHAPTER XXXVIII.

CHAPTER XXXVIII.

Technical Forms of Education in American Universities.

[G. H. KNIBBS.]

1. *Introduction.*—The courses in the Washington University have already been mentioned. That institution has not yet been developed, and hardly claims, as yet, to be a representative American University. It was dealt with in connection with the Polytechnics to shew that the difference was not remarkable. Reference will here be made to the courses, etc., in other Universities of the United States.

2. *Harvard University, Lawrence Scientific School.*—Instituted in 1847, the Lawrence Scientific School at Harvard received its present name to commemorate a gift of 50,000 dollars (say £10,000) from the Honourable Abbott Lawrence. Initially it was an advanced school of science open to graduates and qualified persons of not less than 18 years of age. It is under the Faculty of Arts and Sciences.

The essential feature of the school is that the instruction is arranged in groups of definitely required programmes of courses, each affording through a four-year course the necessary training for one of the scientific professions, viz., engineering, mining, architecture, chemistry, biology, geology, etc. Nevertheless, slight changes may be made to suit the needs of individual students.

Entrance takes place either by examination (fee 5 dollars) or admission from another college or scientific school.

This entrance examination need not be taken altogether. The following is the method :—

> "A candidate for admission to the Lawrence Scientific School may take the entire examination at one time; or he may divide it under the following conditions—(*a*) between two years; or, (*b*) between June and September of the same year. If he divides it between two years, he is known at his first examination as a "Preliminary Candidate"; if between June and September of the same year, as a "Postponing Candidate."

Candidates may be admitted to *advance standing* either by examination, or without examination in case of graduation in other scientific schools. This may be with credits or deficiencies for a particular stage—the deficiencies have, of course, to be made good.

Special students are members of the school who are not recognised in regular standing, or as candidates for a degree.

The scheme of qualification by examination for admission to the first-year class is as follows, the figures representing "points":—

English, 4; elementary German, 2; elementary French, 2; elementary history, 2; elementary algebra, 2; plane geometry, 2: solid geometry, 1. Then he must offer either elementary physics, 2; *or* elementary chemistry, 2; or two of the following, viz.:—Physiography, 1; anatomy, physiology, and hygiene, 1; zoology, 1; botany, 1; astronomy, 1. These aggregating 17 "points." In addition there must be elective studies aggregating 9 "points."

3. *Courses in the Lawrence Scientific School.*—The courses are as follows :—

THE PROGRAMME OF THE LAWRENCE SCIENTIFIC SCHOOL, HARVARD, U.S.A

CIVIL ENGINEERING.

First Year.	Hours per Week.
Algebra (½-year)	3
Trigonometry (½-year)	3
Analytic Geometry (½-year)	3
Mechanical Drawing	1 + 6
Descriptive Inorganic Chemistry	2 + 4
Rhetoric and English Composition	3
German or French	
Experimental Physics	1 + 2
Surveying (6 weeks).	
Geodetic Surveying (2 weeks).	
Railroad Engineering (3 weeks).	
Second Year.	
Differential and Integral Calculus	3
Descriptive Geometry (½-year)	9
Mechanism (½-year)	6
Elementary Statics (½-year)	6
Resistance of Materials (½-year)	6
Steam Machinery	4
Experimental Physics, *or*	1 + 4
General Descriptive Physics	2 + 2
English Composition	2

Third Year.	Hours per Week.
Applied Mechanics	3
Hydraulics (½-year)	3
Thermodynamics (½-year)	3
Engineering Laboratory	2 + 3
Machine Design (½-year)	6
Metallurgy (½-year)	2
Generation and Utilisation of Electrical Energy	3 + 3
Fourth year.	
Common Roads (½-year)	3
Resistance of Materials (½-year)	3
Water Supply and Sanitary Engineering (½-year)	3
Canals, Rivers, and Irrigation (½-year)	3 + 6
Bridges and Buildings	9
Masonry and Foundations (½-year)	3
Engineering Conference	2
Contracts and Specifications (½-year)	1
Elementary Geology (½-year)	3
Elementary Field and Laboratory Geology	2 + 3

MECHANICAL

MECHANICAL ENGINEERING.

First Year.	Hours per Week.
Algebra (half-year)	3
Trigonometry (half-year)	3
Analytic Geometry (half-year)	3
Mechanical Drawing	1 + 6
Descriptive Inorganic Chemistry	2 + 4
Rhetoric and English Composition	3
German *or* French	?
Experimental Physics	1 + 2 + 1
Shopwork—Chipping, Filing and Fitting	90
„ Blacksmithing	90
„ Pattern-making and Foundry Practice	90
„ Machine-shop Practice	90

Second Year.	
Differential and Integral Calculus	3
Descriptive Geometry (half-year)	6
Mechanism (half-year)	6
Elementary Statics (half-year)	6
Resistance of Materials (half-year)	6
Steam Machinery (half-year)	4
Experimental Physics; *or*	1 + 4
General Descriptive Physics	2 + 2
English Composition	2

Third Year.	Hours per Week.
Applied Mechanics	3
Hydraulics (half-year)	3
Thermo-dynamics (half-year)	3
Engineering Laboratory	2 + 3
Machine Design (half-year)	6
Generation and Utilisation of Electrical Energy	3 + 3
Metallurgy (half-year)	3

Fourth Year.	
Resistance of Materials (half-year)	3
Efficiency of Heat Engines (half-year)	3
Heating and Ventilation (half-year)	3
Engineering Laboratory	1 + 9
Machine Design	12
Engineering Conference	2
Contracts and Specifications (half-year)	1

ELECTRICAL ENGINEERING.

The *First* and *Second* years are the same as for *Mechanical Engineering.*

Third Year.	Hours per Week.
Applied Mechanics	3
Hydraulics (half-year)	3
Thermo-dynamics (half-year)	3
Engineering Laboratory	2 + 3
Direct Current Dynamo Machinery	2 + 3
Electrical Measurements	1 + 6

Fourth Year.	Hours per Week.
Alternating Currents and Alternating Current Machinery	3 + 8
Dynamo Design	6
Electrical Engineering Laboratory	1 + 6
Electric Power Transmission and Distribution (half-year)	2
Telegraphy and Telephony (half-year)	2
Electro-dynamics, Magnetism, and Electro-magnetism	2 + 2
Engineering Conference	2
Contracts and Specifications (half-year)	1

MINING AND METALLURGY.

First Year.	Hours per Week.
Algebra (half-year)	3
Trigonometry (half-year)	3
Analytic Geometry (half-year)	3
Mechanical Drawing	1 + 6
Experimental Physics	1 + 2
Descriptive Inorganic Chemistry	2 + 4
Rhetoric and English Composition	3
Modern Language	?

Second Year.	
Differential and Integral Calculus	3
Elementary Statics (half-year)	6
Resistance of Materials (half-year)	6
Steam Machinery (half-year)	4
Experimental Physics; *or*	1 + 4
General Descriptive Physics	2 + 2
Qualitative Analysis	3
Elementary Geology (half-year)	3
Elementary Field and Laboratory Geology (half-year)	2 + 2
English Composition (half-year)	2
Surveying	(11 weeks)

Third Year.	Hours per Week.
Prospecting and Exploring (half-year)	3
Metallurgical Chemistry (half-year)	3
General Metallurgy (half-year)	3
Fire Assaying (half-year)	3 + 2 afternoons
The Study of Mining Operations	(6 weeks)
Mining Geology	3
Mineralogy	3 + 5
Applied Mechanics	3
Generation, Transmission, and Utilisation of Electrical Energy (half-year)	3 + 3

Fourth Year.	
Metallurgy of Iron and Steel (half-year)	3
Metallurgy of Copper, Lead, Nickel, Zinc, and the Minor Metals (Metallurgy) (half-year)	3
Ore Dressing, Concentration, and Milling	3 + 2 afternoons
Metal and Coal Mining	3
Engineering Laboratory	2 + 3

ARCHITECTURE.

ARCHITECTURE.

First Year.

	Hours per Week.
Technical and Historical Development of the Ancient Styles	3 + ?
Elementary Architectural Drawing.—The Orders	4 + 10
Principles of Delineation, Colour, and Chiar-oscuro	3 + ?
Trigonometry (half-year)	3
Analytic Geometry (half-year)	3
Rhetoric and English	3
German *or* French (full course)	?
Elementary Physics	1 + 2

Second Year.

Technical and Historical Development of the Mediæval Styles; *or*	3
Technical and Historical Development of Renaissance and Modern Architecture	3
Freehand Drawing	3 + 3
Elementary Architectural Design	$2\frac{1}{2}$ + 12
Descriptive Geometry.—Elementary Shades, Shadows, and Perspective	4
Stereotomy, Shades, Shadows, and Perspective (half-year)	2
Elementary Statics (half-year)	3
Resistance of Materials (half-year)	3
English Composition	2
German *or* French (full course)	?

Third Year.

	Hours per Week.
Technical and Historical Development of the Mediæval Styles; *or*	3
Technical and Historical Development of Renaissance and Modern Architecture	3
Freehand Drawing	3 + 3
Architectural Design	$2\frac{1}{2}$ + 16
Building Construction.—Carpentry	1 + 2
Theory of Design	6
Masonry and Foundations (half-year)	3
Building Stones (half-year)	3

Fourth Year.

Freehand Drawing	2 + 4
Architectural Design	?
Modelling (half-year)	3
Contracts and Specifications	1

and the equivalent of two courses selected from the following:—

Principles of Design in Painting, Sculpture, and Architecture	3
History of Greek Art	3
The Fine Arts of the Middle Ages and of the Renaissance	3
Classical Archæology	$1\frac{1}{2}$
The Private Life of the Romans	3
The Life of the Ancient Athenians	3
History and Principles of Landscape Design	3
Æsthetics	3
Bridges and Buildings	9
Heating and Ventilation (half-year)	3

LANDSCAPE ARCHITECTURE.

First Year.

	Hours per Week.
Principles of Delineation	3 + ?
Technical and Historical Development of the Ancient Styles of Architecture	3 + ?
Elementary Architectural and Landscape Drawing	4 + 10
Trigonometry (half-year)	3
Elementary Botany (half-year)	2 + 4
Rhetoric and English Composition	3
German *or* French (full course)	?

Second Year.

History and Principles of Landscape Design	3
Principles of Design in Architecture, Sculpture and Painting	3
Elementary Architectural Design	$2\frac{1}{2}$ + 12
Technical and Historical Development of Renaissance and Modern Architecture; *or*	3
Physiography of the Lands	3 + 2
And Meteorology (elementary course)	3 + 2
Horticulture, laboratory work	3
Surveying	6 weeks
English Composition	2
Optional.—Agricultural Chemistry	2

Third Year.

	Hours per Week.
Practice in Landscape Design	9 + ?
Freehand Drawing	3 + 3
Physiography of the Lands	3 + 2
Meteorology	3 + 2
Or, Technical and Historical Development of Renaissance and Modern Architecture	3
Study of plants in relation to planting design (half-year)	2
Elementary Geology	3
Elementary Field and Laboratory Geology	3
Common Roads (half-year)	3
Summer Work in Study of Plants	

Fourth Year.

Practice in Landscape Design	9 + ?
Study of plants in relation to planting design	2
Freehand Drawing	3 + 3
Water Supply and Sanitary Engineering (half-year)	3
Contracts and Specifications (half-year)	1
Masonry and Foundations (half-year)	3
Thesis	?

CHEMISTRY.

First Year.

	Hours per Week.
Descriptive Inorganic Chemistry	2 + 6
Algebra (half-year)	4
Trigonometry (half-year)	3
Mechanical Drawing	1 + 6
Rhetoric and English Composition	3
German *or* French (full course)	?

Second Year.

	Hours per Week.
Analytical Geometry	3
Organic Chemistry	3
Qualitative Analysis	3
Quantitative Analysis, Gravimetric and Volumetric	3
Experimental Physics; *or*	1 + 4
General Descriptive Physics	2 + 2
English Composition	2
German or French (full course)	

CHEMISTRY—*continued.*

Third Year.	Hours per Week.
Differential and Integral Calculus	3
The Carbon Compounds	3
Chemical Philosophy (half-year)	2
Advanced Quantitative Analysis (half-year)	3
Gas Analysis (half-year)	3
An Elective Course	?

Fourth Year.	
Physical Chemistry	3
Industrial Chemistry...	3

Three courses of electives chosen under the direction of the Division from the following list :—

Chemistry. — Electro-Chemistry, Photo-Chemistry, Experimental Electro-Chemistry, Advanced Physical Chemistry, Chemical Kinetics and Equilibrium, Inorganic Chemistry, Physical Chemistry, and Applied Chemistry.

Engineering.—Descriptive Geometry, Steam Machinery, Elements of Thermo-dynamics, Theory of Heat Engines, Heating and Ventilation, Engineering Laboratory, Introductory Course in Experimental Methods, Generation, Transmission, and Utilisation of Electrical Energy, Lectures and Laboratory Work.

Physics. — Electro-statics, Electro-kinematics, and parts of Electro-magnetism.

Botany.—Lectures and Laboratory Practice, Morphology of Plants, Cryptogamic Botany.

Zoology.—Lectures and Laboratory Exercises, Morphology of Animals (Lectures and Laboratory Work).

Geology. — Elementary Geology, Lectures with Collateral Reading, Elementary Field and Laboratory Geology.

Mineralogy. — Mineralogy (including Crystallography, Physical and Chemical Mineralogy and Descriptive Mineralogy, Crystallography and Physical Crystallography, mainly optical, and its applications.

Mining.

Besides the preceding there are organised courses in Geology, Biology, Anatomy and Physiology, General Science, and *Courses for Teachers of Science.*

4 *Colleges at Berkeley, University of California.*—There are nine Colleges at Berkeley, four of which are devoted to general culture, viz. : (1) College of Letters, (2) College of Social Sciences, (3) College of Natural Sciences, and (4) College of Commerce, and five are Colleges of Applied Science, viz. : (5) College of Agriculture, (6) College of Mechanics, (7) College of Mining, (8) College of Civil Engineering, and (9) College of Chemistry. The course in each is of four years' duration, leading directly to a corresponding degree.

There are Courses for (*a*) Undergraduates and (*b*) for Graduates. For admission to the Undergraduate Courses applicants must be at least sixteen years of age, must give satisfactory references concerning moral character, and must, by examination or by certificate, give evidence of proficiency in such subjects as the following, viz. : Oral and Written Expression, English, Algebra, Civil Government and American History, Latin, Greek, Ancient History, History, Physics, Advanced Mathematics, Chemistry, Botany, Zoology, Physical Geography, Mediæval and Modern History, English History, French, German, Spanish, Freehand and Geometrical Drawing.

For participation in the Graduate Courses, students holding the degree of Bachelor of Arts, Letters, Philosophy, or Science, from an institution authorised by law to confer these degrees, or holding any other degree or certificate which the Graduate Council may accept as equivalent, may be admitted upon presenting official credentials.

The subjects admitting in particular to the Undergraduate Courses in the Colleges of Agriculture and Chemistery are : Oral and Written Expression, English, Algebra, Plane Geometry, Civil Government and American History, and either Latin, Greek, English, Elementary French, or Elementary German, Physics, either Advanced Mathematics, Botany, Zoology, or Physical Geography, and Chemistry. The subjects for entrance to the Colleges of Mechanics, Mining, and Civil Engineering are the same, except that Freehand Drawing is taken and only part of the Advanced Mathematical Course, viz. : Solid Geometry and Plane Trigonometry.

Entrance examinations are held for students who present certificates from their teachers that they are prepared in the subjects they offer.

Candidates are admitted (*a*) on examination and conditionally (*b*) without examination from the following Institutions :—

(i) *Accredited Schools in California.*—Graduates of these being admitted to the Courses when they have the personal recommendation of the Principal, accompanied by a certificate attesting to the completion of their preparatory studies.

(ii) *California State Normal Schools.*—Graduates of these schools are admitted by a provision of the Academic Senate as students in regular standing for the first year.

(iii) *Secondary Schools outside of California.*—A recommended graduate provided with certificates from these schools is received only if the school which he attended has been examined and accredited by some college or university at which the entrance requirements are equivalent to those of the University of California. In fact, the same conditions are necessary with respect to the Secondary Schools within the State of California.

Candidates are also admitted on Teachers' Diplomas. Holders of these may be admitted to the University as regular students, with the privilege of satisfying matriculation requirements by examination or by work in the University.

Advanced standing in Undergraduate Courses is given to applicants if they possess certificates from other colleges and universities, upon their approval by the proper committee.

Final examinations and also —in the case of year courses—mid-year examination are assigned for all undergraduate courses, from which no student will be excused.

Any undergraduate who, at the end of any half-year, fails to pass in at least five units of new work, *will be dropped from the roll*, excepting, of course, in cases where they have registered for less than five units of new work. But any undergraduate who is a regular or limited student will have an opportunity to re-enter after an interval of one half-year, provided that during the interval his deficiency is made good, and provided as a condition of further university work, he first removes all matriculation deficiencies for the status of a regular student.

It

It may be stated that the students of Berkeley are thus classified, viz.:—(1) *Graduate students*; (2) *regular students* or undergraduates who pursue or are entitled to pursue the established curriculum of a college; (3) *Students at Large* are those undergraduates who pursue purely elective courses though devoting to study the full time required of regular students; (4) *Special students*, or *partial course students* of mature age and character, admitted to courses upon demonstrating requisite ability and preparation; (5) *Limited students* or *partial course students.*

Tuition in the various Colleges at Berkeley, including the use of the libraries is FREE to residents of the State of California, but non-residents are charged a fee of 10 dollars per half-year. All students must pay for the material used in the laboratories, which amounts from 5 dollars to 30 dollars (say, £1 to £6) annually; for military uniforms, gymnasium locker and suit, and for books and stationery.

Board and lodging may be obtained in private families, costing from 18 to 30 dollars a month; from students' boarding clubs, at a rate of from 15 dollars to 22 dollars a month; and students may board themselves for the sum of 10 dollars a month. *Students may support themselves during their course, providing they have sufficient money for the first year.* The Young Men's and Young Women's Christian Associations act as bureaus for those in quest of remunerative employment.

A large number of Prizes, Fellowships, and Scholarships have been founded and established in connection with the University of California.

The various colleges of Applied Science at Berkeley, viz., those devoted to Mechanics and Electrical Engineering, Mining, Civil Engineering and Chemistry will now be referred to in detail.[1] It is unnecessary and foreign to the purpose of this report to further remark upon the Colleges giving general culture.

5. *College of Mechanics, Berkeley, University of California.*—The College of Mechanics includes also the courses in electrical engineering, both of which are designed for students who wish to become professional engineers, or to engage in any of the lines of manufacture and construction allied to the mechanical and electrical industries. The course is of four years' duration, and the B. S. degree is conferred on students who have successfully passed through. The curriculum of study is as follows:—

PROGRAMME IN MECHANICS, UNIVERSITY OF CALIFORNIA.

Subjects.	First Half-year.	Second Half-year.
Freshman Year.		
Mathematics:		
Elements of Analysis, with applications. A practical course in Algebra, Analytic Geometry, and the Elements of Differential Calculus, adapted particularly to the needs of students in engineering	5	5
Physics:		
Elementary Course; Laboratory and Lectures	3	3
Chemistry:		
General Inorganic, Metals and Non-metals, Lectures	3	3
Laboratory Experiments and Qualitative Analysis	2	2
Drawing:		
Instrumental and Descriptive Geometry	2	2
Military Science:		
Two exercises each week	½	½
Physical Culture	...	...
Totals	15½	15½
Sophomore Year.		
Mathematics:		
Elements of Analysis, with applications. Differential and Integral Calculus, with applications to Geometry	3	3
Problems in the Calculus	...	(2)[2]
Mechanical Engineering:		
Mechanical Practice	2	(2)
Physics:		
General Course	3	3
Physical Measurement	2	2
Drawing:		
Descriptive Geometry and Mechanical Drawing	2	2
Civil Engineering:		
Lectures, with Field Practice and Mapping	3	3
Military Science:		
Two Exercises each week	½	½
Physical Culture	...	...
Totals	15½	15½

[1] The College of Agriculture is referred to in Chapter XLVI.
[2] The numbers in brackets represent alternative electives.

Subjects.	First Half-year.	Second Half-year.
Junior Year.		
Mathematics:		
Differential Equations	3	...
Astronomy:		
Method of Least Squares	(3)[1]	...
Mechanical Engineering:		
Mechanical Practice	2	(2)
Electrical Machinery and Laboratory Tests	2	3
Mining:		
Metallurgy, Structural Metals, Fuels	(2)	...
Physics:		
Analytic Mechanics	4	4
Absolute Electrical Measurements	...	(3)
Electricity	(2)	...
Civil Engineering:		
Strength of Materials	...	4
Drawing:		
Graphostatics and Mechanical Drawing	2	2
Military Science:		
Two Exercises each week	½	½
Totals	15½–16½	15½–16½
Senior Year.		
Mechanical Engineering:		
Hydrodynamics	3	...
Hydraulics	...	3
Thermodynamics	3	3
Kinematics	2	3
Military Science:		
Theoretical Course	1	1
Thesis:		
Upon some Subject in Mechanical or Electrical Engineering	...	...
Electives Either of the Subjoined Groups:—		
I. General: Hydrodynamics: Problems	2	...
I. General: Hydraulics: Problems	...	2
I. General: Mechanical Laboratory	2	2
I. General: Physical Laboratory	(3)	...
I. General: Drawing: Construction	(2)	(2)
I. General: Drawing: Elective	...	(2)
Electrical Engineering:		
Alternating Currents and Alternating Current Machinery Lectures	4	4
Laboratory, Electrical Design	3	3
Totals	16	16-17

The mechanical and electrical engineering laboratories are designed to offer facilities for tests and experimental inquiry, such as (1) submitting the actual test, and verifying directly, principles developed in the lecture-room; (2) building and testing machines designed by the students; (3) investigating such objects and engineering problems as are calculated to impart training in methods of investigation, and to yield results which may prove of value in engineering science; (4) ascertaining the character and proper treatment of materials, and acquiring familiarity with the appliances and processes necessary for the construction of designs. Opportunity is offered the student to acquire skill, under the instruction of an able mechanician, in the working of metals by hand and machine tools; in wood-turning, planing, and carpentry; in moulding and pattern-making; in forging and tempering tools. These processes are well illustrated in the construction of machines for experimental work. After the student has become sufficiently acquainted with the processes, and is able to recognise differences in appliances and methods, visits of inspection are made to manufacturing establishments and power stations in San Francisco and its vicinity, in order to give him familiarity with engineering operations on a large.

The laboratories will be referred to more fully hereinafter.

To obtain the degree of Mechanical Engineer (M.E.) a candidate must be a graduate of this College, or must have successfully completed an amount of work equivalent to the regular undergraduate course; and must pass a satisfactory examination in the following studies; thermodynamics, construction of hydraulic motors and heat engines, dynamo-electric machinery, machine construction, and general machine design. The applicant must also have engaged for at least one year in professional work, in addition to the time spent in graduate study; and must present an original memoir upon some subject bearing upon his profession. This degree is only given three years after completion of the undergraduate work.

[1] The numbers in brackets represent alternative electives.

6. *College of Civil Engineering Berkeley.*—The organisation of the college is as follows :—

The admission requires—(1) Oral and written expression, English, Algebra, up to simple quadratics, plain geometry, History and Government of the United States, Elementary Physics, either Latin or Greek, or English or French, or German, Solid and Spherical Geometry, Plain Trigonometry, Chemistry, Freehand Drawing.

The Freshman and Sophomore years are alike for all. The courses in *Irrigation Engineering* are the same as for other Civil Engineering courses, except that they omit Mineralogy and Shop-practice and add three elective "units" in the Sophomore year.

At the beginning of the junior year the general course divides into three branches—(1) Railroad Engineering, (2) Sanitary Engineering, (3) Irrigation Engineering, and this division is maintained in the senior year.

The undergraduate course in the Civil Engineering comprehends three great divisions of work. First, Surveying, Practical Astronomy, Railroad Location, Topography, Mapping, etc., which may be called Field Engineering ; second, Civil Engineering Construction, embracing the scientific methods of Designing and Constructing Roofs, Bridges, Sanitary Systems, Retaining Walls, Dams, Roads, Canals Railway Structures, etc., ; and third, the applications of the principles of Civil Engineering to the practical problems of Irrigation.

As much time as is practicable, including a summer class in surveying, is given to the first division of work, with the intention of rendering the students skillful and ready in the use of the instruments and methods adopted by the best Field Engineers.

Full theoretical discussion is given to the different topics in constructive engineering ; and practical application and illustration are given at length in the engineering draughting-rooms.

The programme of the course in Civil Engineering is as follows :—

Subjects.	First Half-year.	Second Half-year.
Freshman Year.		
Mathematics : Elements of Analysis, with applications	5	5
Physics : Elementary Course, Lectures and Laboratory	3	3
Chemistry : Inorganic, Lectures	3	3
Laboratory experiments and qualitative analysis	2	2
Drawing : Instrumental and Descriptive Geometry	2	2
Military Science : Two exercises each week	$\frac{1}{2}$	$\frac{1}{2}$
Physical Culture	...	...
Totals	$15\frac{1}{2}$	$15\frac{1}{2}$
Sophomore Year.		
Mathematics : Elements of Analysis, with applications	3	3
Problems in the Calculus	...	2
Physics : General Course	3	3
Laboratory	2	3
Drawing : Descriptive Geometry	2	...
Civil Engineering : Lectures	2	2
Field-practice and Mapping	1	1
Topography	...	1
Mineralogy : Laboratory	(2)	(2)
Or, Mechanical Engineering : Shop-practice	(2)	(2)[1]
Military Science : Two exercises each week	$\frac{1}{2}$	$\frac{1}{2}$
Physical Culture	...	...
Totals	$15\frac{1}{2}$	$15\frac{1}{2}$

[1] The numbers in brackets represent alternative electives.

Subjects.	Half-years.					
	Rail.	Eng.	San.	Eng.	Irrig.	Eng.
	1	2	1	2	1	2
Junior Year.						
Railway, highway, and canal surveying	3	...	3	...	...	...
Field practice and mapping	2	...	2	...	...	...
Summer class, four weeks	...	...	...	...	...	...
Railroad economics	...	3	...	...	...	...
Strength of materials	...	4	...	4	...	4
Materials of construction	2	...	2	...	2	...
Laboratory	...	1	...	1	...	...
Framed structures	...	3	...	3	...	...
Astronomy.—Least squares	2	...	...	...	...	...
Physics.—Analytic mechanics	4	4	4	4	4	4
Drawing.—Graphostatics	2	...	2	...	2	...
Military science.—Two exercises each week	½	½	½	½	½	½
Sewer systems	...	...	...	2	...	...
Free electives	...	...	2	1	1	1
Irrigation, engineering, and economics	...	...	...	...	3	2
Agriculture	...	...	...	...	3	3
Senior Year.						
Structural design	3	3	3	3	...	...
Highways and pavements	...	2	...	2	...	...
Foundations	...	2	...	2	...	2
Laboratory and lectures	3	2	2	2	...	...
Higher surveying	...	2	...	...	...	...
Mechanical engineering—Hydrodynamics	3	...	3	...	3	...
Astronomy—Practical course	3	1	...	...	...	...
Geology—General course	3	...	3	...	...	...
Military science—Theoretical course	1	1	1	1	1	1
Thesis—A problem of investigation in some engineering subject	...	3	...	3	...	...
Water supply	...	...	...	3	...	...
Construction of dams	...	...	3	...	3	...
Free electives	...	...	1	...	3	7
Irrigation.—Institutions and laws	...	...	...	...	3	...
Framed structures	...	...	...	...	...	3
Agriculture and horticulture, general course	...	...	...	...	3	3

7. *Regulations with Regard to the Degree of Civil Engineer.*—Candidates must be graduates of the College of Civil Engineering of the University of California, or must have successfully completed a course of study equivalent to the regular undergraduate course; and must pass a satisfactory examination in the following subjects:—Railway tunnels; principles of construction of walls, arches, domes, retaining walls; specifications and contracts; engineering and irrigation laws, irrigation engineering, etc.; standard authors upon river and harbour engineering; practical astronomy; drawing and designing of engineering structures; English, and either history or political economy. They must have had at least one year of actual practice in the profession, and must present an acceptable original memoir upon some subject bearing upon the profession. The degree is not to be given earlier than three years after completion of the undergraduate work.

8. *College of Mining and Metallurgy, Berkeley University of California.*—The courses in this College are designed for those who wish to become mining or metallurgical engineers, or to engage in any of the pursuits connected with the mining industry, such as the surveying and mapping of mines, the assaying and working of ores, the designing and use of mining and machinery, or the exploitation of mines. The course is of four years' duration, but students are advised that the devotion of another year to the study of mining is very much to be desired.

The

The following is the course of study, leading to the degree of B.S. :—

Subjects.	First Half-year.	Second Half-year.
Freshman Year.		
Mathematics.—Elements of Analysis, with applications	5	5
Physics.—Elementary Course: Lectures and laboratory	3	3
Chemistry.—Inorganic: Lectures	3	3
Laboratory experiments and qualitative analysis	2	2
Drawing.—Instrumental and Descriptive Geometry	2	2
Military Science.—Two exercises each week	½	½
Physical Culture	..	...
Totals	15½	15½
Sophomore Year.		
Mathematics.—Elements of Analysis, with applications	3	3
Physics.—General Course: Lectures	3	3
Laboratory	2	2
Chemistry.—Quantitative Analysis: Laboratory	3	3
Mineralogy.—Laboratory	1	1
Civil Engineering.—Lectures, with Field Practice and Mapping	3	3
Summer class, four weeks...	...	...
Military Science.—Two exercises each week	½	½
Physical Culture	...	...
Totals	15½	15½
Junior Year.		
Geology.—General course	3	...
Mineralogy.—Crystallography, physical properties	2	1
Descriptive...	...	2
Mining.—Structural metals, fuels	2	...
Assaying	2	2
Lectures and laboratory	...	2
Summer class, one month	...	...
Physics.—Analytic mechanics	1	4
Civil Engineering.—Strength of materials	...	4
Drawing.—Graphostatics...	2	...
Military Science.—Two exercises each week	½	½
Totals	15½	15½
Senior Year.		
Geology.—Field work	1	2
Petrography	3	2
Economic	...	3
Mining.—Ore-crushing, sampling, and fluxing	2	...
Gold, silver, quicksilver	2	...
or Metallurgical laboratory	(2)	(2)
Lead and copper	...	2
Lectures	4	4
Thesis	...	...
Mechanical Engineering.—Hydrodynamics	3	...
Military Science.—Theoretical course	1	1
Totals	16	14-16

The conditions required for the degree of Mining Engineer are that the candidate must be a graduate, or must have successfully completed a course of study equivalent to the regular undergraduate course, and must pass a satisfactory examination in the following subjects: mining, ore-dressing, petrography, economic geology, the elements of thermodynamics, construction of mining machinery, and political economy. The applicant must have had at least one year of actual practice in the field in the course chosen, and must testify to his power of applying to practice the knowledge acquired. The conditions are the same for the degree of Metallurgical Engineer, except that the candidate must pass a satisfactory examination in metallurgy, ore-dressing, assaying and analysis, the elements of thermodynamics, construction of furnaces and metallurgical machinery, and political economy. This degree is given only after three years from the date of completion of the undergraduate work.

The *Special Students* of the College, who are not able to follow the undergraduate course, may devote their attention to mining, metallurgy, and assaying and the allied subjects, provided they have the necessary preparation for the courses they elect. Their preparation must be equivalent to the regular entrance requirements in either (a) Mathematics, Algebra, and Plane Geometry, or (b) Physics, or Chemistry. In order to take advanced work in mining, they must also have the same prerequisites for the courses they elect as regular students.

For students desiring to pursue advanced or special work after graduation every facility will be afforded by the libraries, laboratories, and collections of the University.

9. *College of Chemistry, Berkeley, University of California.*—The course of instruction afforded in this College is designed for those who aim at becoming *professional chemists* and for those who desire a thorough grounding in the science of chemistry, both theoretical and practical, as a preparation for teaching, or for the study and practice of medicine, pharmacy, metallurgy, etc. While chemistry is the prominent study of the College, opportunity is given to pursue a somewhat extended range of studies in the other sciences; and such a selection of elective studies may be made as to meet the special needs of several classes of students. The course is a four-year one, a description of which being given hereunder:—

CURRICULUM OF COURSE IN COLLEGE OF CHEMISTRY.

Subjects.	First Half-year.	Second Half-year.
Freshman Year.		
Chemistry.—General Course and Laboratory Practice	5	5
Elementary Course in Physics	3	3
Mathematics.—Elements of analysis, with applications	5	5
English.—General History of English Literature	3	3
Military Science.—Two exercises each week	½	½
Physical Culture	...	...
Totals	16½	16½
Sophomore Year.		
Chemistry.—Quantitative Analysis	3	...
Organic: Lectures...	2	...
Physics.—General Course, with Laboratory practice	5	5
French *or* German.—Introductory Course	3	3
Electives	2	7
Military Science.—Two exercises each week	½	½
Physical Culture	...	...
Totals	15½	15½
Junior Year.		
French *or* German.—Second-year courses	3	3
Electives	12	12
Military Science.—Two exercises each week	½	½
Totals	15½	15½
Senior Year.		
Electives	11	14
Thesis—embodying the results of investigation, under the direction of the Professor of Chemistry	...	...
Military Science.—Theoretical Course	1	1
Totals	15	15

This Course leads to the Degree of B.S.

10. *Equipment of Colleges and Departments.*—Beside the colleges and departments referred to in section 1 of this chapter, there are several others, viz., the Lick Astronomical Department; the Mary Hopkins' Institute of Art; the Hastings College of the Law; the Medical Department; the Post-graduate Medical Department; the Dental Department; the California College of Pharmacy.

The Colleges are well-equipped. The following comments are an indication of the extent of the equipment:—

The *Civil engineering and machine models, and the survey and hypsometrical apparatus* are moderately good.

In the agricultural department there are about 2,500 specimens of *soils* of California, collections of *cereals and seeds.* Of olive seeds there are 57 varieties.

The *Psychological laboratory* is equipped for research as well as instruction. There is a *Botanical garden,* and also laboratories, and a conservatory.

The *Zoological laboratories* are equipped for elementary and advanced work in general morphology, miscroscopical anatomy, embryology, etc. The *Physiological laboratories* are equipped with reference to general and comparative physiology.

The *Mineralogical and petrographical laboratories* are exceptionally well-equipped.

The *Mechanical and Electric laboratories* are well-equipped both for instruction and research. Details will be given later of the electrical, and civil engineering, and metallurgical laboratories.

There is a research laboratory; mining laboratories, with gold- and silver mill, chlorination-room, cyanide and hyposulphite leaching rooms, forge and drilling rooms, power and work shops, lecture-rooms and museums; laboratories of agricultural chemistry; viticulture; bacteriology and entomology; a special laboratory for physical properties of soils, etc.; a laboratory of agricultural chemistry, etc., etc.

11. *Detailed equipment of some of the laboratories.*—The Electrical Engineering Laboratories comprise the main power-room and dynamo, electrical testing, photometric, and standardising laboratories.

The main power-room contains a Ball engine of 100 horse-power, which drives through a counter-shaft a 50-kilowatt polyphase experimental alternating-current generator, a 30-kilowatt single phase, 1,000-volt alternating current generator, a 20 kilowatt compound wound, constant-potential generator, which

which may be used as a dynamo or motor, and a 10-kilowatt arc lighting dynamo. The installation in this room is a typical central station of its kind, and is arranged primarily for experimental work. Mains are run from the station switch-board in this room to the large laboratory switch-boards in the dynamo laboratory, making a flexible system throughout.

The Dynamo Laboratory contains a 50 horse-power straight-line engine, belted through counter-shafting and friction clutches to twenty-two dynamos and motors especially arranged for experimentation and investigation. When a variable speed is desired current is taken from the main power-room and the laboratory is driven by motors.

The machines are of different capacities, ranging from 15 kilowatts down, and represents, as far as possible, the best American practice in dynamo machine construction. The continuous current, constant potential, and constant current types, and single and multiphase alternating current machines and induction motors are all represented in this laboratory, including three experimental dynamos constructed by the students in the machine shop. A number of Brackett dynamometers, also made by the students, may be used in efficiency tests. The switch-boards, for direct and alternating current, containing over 400 terminals each, are connected with the machines, and also with the instrument tables, containing thirty Weston alternating and direct current ammeters, coltmeters, and wattmeters. A bank of eight transformers and liquid, metal, arc, and incandescent lamp resistances, also have connections with the switch-boards. A kilowatt, 50,000-volt, oil-insulated transformer is used for high voltage and insulator tests. The testing and standardising laboratories contain a full equipment of accurate scientific and commercial instruments, among which may be mentioned three Kelvin electric balances, four Kelvin electrostatic voltmeters, an Anthony Wheatstone bridge, four Nalder-Wheatstone bridges, and a permeameter, magnetometer, and Ewing curve-tracer for magnetic investigations. These two laboratories and the photometric laboratory have sub-switch-boards connected to the main switch-board in the dynamo-room. In connection with the photometric and other experiments requiring an unvarying potential, a storage battery of sixty chloride cells is available. The rooms are all supplied with solid masonry piers for the mounting of sensitive instruments.

For experiments in thermodynamics and steam engineering, the 100 horse-power Babcock-Wilcox boiler, four steam-engines, a 3½-in. Jackson centrifugal pump, a small March steam-pump and two gas-engines of the department are used, having been erected with all accessories for investigation.

For the experiments in hydraulics there are available the water tanks, gauges, and meters, and various types of motors and turbines. There are also appliances for efficiency tests and determination of the resistance to rotating discs and cylinders in water.

The testing-room contains machines for tension, compression, and torsion of different capacities, and a wire-testing machine for experiments on cables and ropes.

The civil engineering laboratory has a latest improved Olsen automatic and autographic testing machine of 200,000 lb. capacity, a Riehlé cement-testing machine of 2,000 lb. capacity, a Fairbanks automatic cement-testing machine, a Clark and Mills four-cylinder abrading machine, an automatic sifter, a Clark and Mills impact machine, a new Thurston torsion machine, and a drying oven for moisture tests.

In the metallurgical laboratories, the assaying laboratory is equipped to give instruction by the most improved method in the fire assays of gold, silver, lead, antimony, tin, iron, nickel, cobalt, and quick-silver ores, and furnace products.

The crushing and sampling room contains a Taylor sample-crusher, large iron mortars and rubbers; a panning sink, with full assortment of miners' pans, horns, bateas, aud other devices for making vanning tests of ores; a complete assortment of sieves and a large sampling table. In this room the small-scale sampling is done, and the sample is prepared for assaying. From here the sample goes to the fluxing room. This is provided with eight Becker pulp-scales, and desks containing all the necessary fluxes; it also contains a Fairbanks platform scale graduated in kilogrammes, as well as pounds, for convenience in large scale-tests. The sample after fluxing goes to the furnace rooms These contain four crucible furnace and three muffle furnaces for burning soft coal, like those used in Freiburg, Přzibram, and Colorado. All these furnaces have been carefully designed, built in the walls, and iron-clad in a substantial manner. Besides these, examples of eight portable charcoal and gasoline furnaces commonly used are also provided to familiarise students with their use.

12. *Technical Courses in Cornell University, Ithaca.*—Agriculture and Veterinary Science as taught at Cornell are referred to in another chapter. There are Colleges of Architecture, of Civil Engineering, and of Mechanical Engineering and the Mechanic Arts. (Sibley College.)

The conditions of entrance are—candidates must, if males, be at least 16 years of age; if females 17; in Law candidates must be 18. Applicants must have certificates of character and of honourable dismissal from their colleges.

Entrance is:—(1) by examination; (2) without examination. In the latter case candidates may be admitted (i) On Regent's credentials; (ii) on school certificates; (iii) on certificates of the College Examination Board; (iv) or as special students.

Admission to advanced standing may take place on examination, without full examination.

Students deficient in any subject, but nevertheless admitted, must make good all deficiencies within one year.

Tuition is free to holders of State scholarships, to New York State students in the Veterinary College, etc. The fees in Architecture, or Civil Engineering, or Mechanical Engineering are 125 dollars (say £25) per annum for either regular or special students.

In Sibley College there is a fee of 10 dollars per *half-year* for materials, etc. Five dollars is the baccalaureate fee. Living costs 300 to 500 dollars per annum.

13. *Course in Architecture, Cornell*—The idea obtaining at Cornell is that a properly-organised course in architecture falls under four main divisions, viz.:—

I. *Construction*, practical and theoretical.
II. *Expression, i.e.*, technical representation of architectural ideas on paper.
III. *Composition, i.e.*, science of planning and conveniently arranging buildings, etc.; the art of architectural and decorative design.
IV. *History and Literature of Architecture*, and of matters cognate thereto.

For

For admission advanced French or German is required, but not Greek or Latin.

There are *two courses*—(A) and (B)—the essential difference being that in the latter mathematics are omitted, and the drawing is advanced.

There is also a course in *Architectural Engineering*, a modification of the (A) course.

Besides these there are:—(1) A two-year course in architecture; and (2) a two year course in painting.

The following programme will disclose the difference of the courses :—

PROGRAMME IN ARCHITECTURE—CORNELL UNIVERSITY.

Subjects.	A Course.		B Course.	
	Term 1.	Term 2.	Term 1.	Term 2.
Freshman Year.				
History of Architecture ...	3	3	3	3
Elements of Architecture ...	3	3	6	...
Differential Calculus ...	1	2	...	...
Integral Calculus	...	3	...	...
Analytic Geometry ...	4	...	...	...
Design	...	...	...	8
Freehand Drawing... ...	3	3	6	...
Descriptive Geometry, Civil Engineering	3	...	3	...
Shades and Shadows ...	...	1	...	1
Perspective	...	2	...	2
Clay Products and Building Stone	...	...	...	2
Composition	...	...	...	1
Sophomore Year.				
History of Architecture ...	3	...	3	...
Mechanics	3	...	3	...
Design	8	8	8	10
Drawing from the Antique...	3	3	3	3
Modelling	...	...	...	2
Masonry Construction ...	...	2	...	2
Clay Products, etc.... ...	...	2	...	...
Composition	...	1	...	...

Subjects.	A Course.		B Course.	
	Term 1.	Term 2	Term 1.	Term 1.
Junior Year.				
History of Painting and Sculpture	1	1	1	1
Structural Details	3	...	3	...
Design	...	10	...	12
Modelling	...	2	...	...
Planning of Domestic Buildings	2	...	2	...
Specifications	1	...	1	...
Working Drawings ...	5	...	5	...
Steel Construction and Fire-proofing	3	...	3	...
Heating and Ventilating ...	...	1	...	1
Water-colour Painting ...	...	2	...	2
Timber Physics	1	...	1	...
Physics	2	2	2	2
Senior Year.				
Modern Architecture ...	...	2	...	2
Stereotomy, Masonry Arch.	2	...	2	...
Pen-and-ink Drawing ...	...	...	...	2
Design	12	12	12	12
Life Class	2	...	2	...
Seminary	1	...	1	1

In Architectural Engineering the first three years are those of course (A), excepting that the mechanics is somewhat varied. The Senior Year is special work to suit individual cases, or any or all of the following subjects, viz.:—

Engineering laboratory, 2, 2 ; materials of construction, ..., 5 ; testing materials, 3, ... ; structural design, 4 5 ; stereotomy and masonry arch, 3, 3 ; masonry foundations, ..., 5 ; the figures denoting the hours in the two terms.

The Two-year Course in Architecture is organised as follows, but students may substitute another subject if they are already proficient in any one in the list :—

PROGRAMME OF TWO-YEAR ARCHITECTURAL COURSE—CORNELL.

Subject.	Year I.		Year II.	
	Term 1.	Term 2.	Term 1.	Term 2.
History of Architecture	3	3	3	...
Design	8	8	12	12
Freehand Drawing and Antique	3	3	3	3
Descriptive Geometry	3	...	...	...
Shades and Shadows	...	1	...	...
Perspective	...	2	...	...
Modelling	...	2	...	...
Modern Architecture	...	...	...	2

The *Two-year Course in Painting* was developed on the principle that the bonds between artist, scholar, and scientist should become closer so that each will see the world in truer perspective; thus students in the different branches of the fine arts, etc., receive mutual advantage from living and working together.

14. *Course in Civil Engineering, Cornell.*—The course in Cornell in Civil Engineering is one of high reputation. For admission the candidate must offer English and history, viz., American, including civil government, or English history, or mediæval and modern European, or ancient; plane geometry, elementary algebra, and also solid geometry, advanced algebra, plane and spherical trigonometry; advanced French or advanced German.

There are two regular courses, viz., a four-year course leading to the degree of Civil Engineer—C.E., and a six-year course leading to the two degrees, A.B. and C.E. Besides these there are special and graduate courses.

The

The degree Master of Civil Engineering—(M.C.E.)—is given to those possessing the C.E. degree, on presenting a satisfactory thesis, and passing a special examination. It may also be conferred after two years' professional practice and study *in absentia*, but the candidates are required to appear in person for examination. The degree of Doctor of Philosophy (Ph.D.) may also be acquired.

(Programmes in Civil Engineering, Cornell University.)

Subject.	Four-year Course.		Six-year Course.	
	Term 1.	Term 2.	Term 1.	Term 2.
Freshman Year.				
Analytical Geometry	4	...	4	...
Differential Calculus	1	2	1	2
Integral ,,	...	3	...	3
Botany	...	...	3	...
Chemistry or Drawing	6	...	6	...
Drawing or Chemistry	...	6	...	6
Physics	5	5	...	...
Land Surveying	...	3	...	...
Elective in Arts and Science	...	...	4	7
Sophomore Year.				
Dendrology	2	...	...	...
Geology	2 1	... 3	2 1	... 3
Descriptive Geometry	5	...	5	...
Mechanics	5	5	...	...
Engineering Laboratory	2	2	...	...
Materials of Construction	1	5	...	...
Lettering, Shading, etc.	1	1	...	...
City Surveying	...	2	...	...
Elective in Arts and Sciences	...	...	6	11
Physics	...	...	4	4
Junior Year.				
Political Economy	3	3	3	3
Railroad Engineering	4	4	...	...
Structural Design	4	5	...	...
Hydraulics	5	...	...	...
Hydraulic Laboratory	...	1	...	...
Municipal Engineering	2	5	...	...
Field Construction (alternate years)	...	1	...	...
Mechanics	...	...	5	5
Engineering Laboratory	...	...	2	1
Land Surveying	...	...	...	3
Elective in Arts and Sciences	...	...	8	6
Senior Year.				
Stereotomy and Masonry Arch	3 or	3	3 or	3
Geodesy and Astronomy	5	...	5	...
Geodetic Laboratory	...	1	...	1
Cartography	...	2	...	2
Elective Engineering	4	...	4	...
Steam Machinery	4	...	4	... Sixth Year.
Engineering Problems	...	3	...	3
Engineering Jurisprudence	...	2	...	2
Field Construction (alternate years)	...	1	...	1
Elective	5 or 3	3 or 5	5 or 3	3 or 5
Thesis	...	...	...	...
Materials of Construction	...	...	...	5
Engineering Laboratory	...	...	...	1
Lettering, Tinting, Shading	...	...	1	1
City Surveying	...	...	...	2
Elective in Arts and Sciences	...	...	17	9
Fifth Year.				
Railroad Engineering	...	...	4	4
Structural Design	...	...	4	5
Hydraulics	...	...	5	...
Hydraulic Laboratory	...	...	...	1
Municipal Engineering	...	...	2	5
Field Construction (alternate years)	...	...	...	1
Elective	...	...	3	3
Sixth Year.				
Same as Fourth Year in Four-year course —*see* above.				

15. *Sibley College of Mechanical Engineering.*—The Sibley College of Mechanical Engineering and the Mechanic Arts, at Cornell University, has a large number of departments, viz :—

I (M.E.) Department of Mechanical Engineering.
II (X.E.) „ Experimental Engineering, or Mechanical Laboratory Instruction.
III (E.E.) „ Electrical Engineering.
IV (M.A.) „ Mechanic Arts.
V (D.) „ Industrial Drawing and Art.
VI (M.D.) „ Machine Design.
VII (M.C.) Graduate School of Marine Engineering and Naval Architecture.
VIII (R.) „ „ Railway Mechanical Engineering.

Chemical Engineering can also be studied in this college.

The thesis must be a record of some special study or investigation, either theoretical or experimental.

The Freshman and Sophomore years are common to the courses M.E., E.E., M.C.—*i.e.*, I, III, VII. They are also as follows :—

PROGRAMME IN FIRST AND SECOND YEARS, SIBLEY COLLEGE, CORNELL.

Subjects.	Freshman—		Sophomore—	
	Term 1.	Term 2.	Term 1.	Term 2.
German or French	3	3	...	...
Analytic Geometry	4	...	...	...
Descriptive Geometry	...	...	2	2
Differential Calculus	1	2	...	...
Integral Calculus	...	3	...	...
Chemistry or Drawing	6	...	5	...
Drawing or Chemistry	...	6	...	5
Mechanics of Engineering	...	...	5	5
Physics	...	...	4	4
Shop-work	3	3	3	3

The other parts of the course differ.

16. *Course in Mechanical Engineering, Cornell.*—The following is the programme for the Junior and Senior Years :—

PROGRAMME OF COURSE IN MECHANICAL ENGINEERING, CORNELL.

Subject.	Junior Year—		Senior Year—	
	Term 1.	Term 2.	Term 1.	Term 2.
Steam Machinery	...	4	...	...
Steam Engines, other Motors	...	...	5	2
Electrical Engineering	4	...	...	...
Drawing and Design	2	2	...	...
Kinematics and Kinetics	3	...	...	...
General Machine Design, Engine Design	...	3	4	...
Designing	...	...	2	3
Materials of Engineering	2	...	...	...
Physical Laboratory	2	2	..	...
Mechanical Laboratory	3	3	3	1
Shop-work	3	3	...	...
Thesis, Laboratory Investigations, etc.	...	...	...	8
Elective	...	...	2	3·5

17. *Course in Electrical Engineering, Cornell.*—The Junior Year is as in the programme above, excepting that Electrical Machinery should be substituted for Electrical Engineering. The Senior Year is then as follows:—

PROGRAMME OF COURSE IN ELECTRICAL ENGINEERING, CORNELL.

Subjects.	Senior Year— Term 1.	Senior Year— Term 2.
Physics, Laboratory Work	4	4
Do Lectures	1	1
Steam Engines, other Motors	5	2
Mechanical Laboratory	3	1
Electrical Engineering	5	3
Do. Machinery	2	...
Thesis, Laboratory, Drawing, Shop	...	8

18. *Courses in Marine Construction, Cornell.*—There are two courses, viz., one for Marine Engineers, and one for Naval Architects. They are organised as follows:—For the Junior and Senior Years, viz.:—

Programme for Marine Engineers and Naval Architects, Cornell.

Subjects.	Marine Engineers.		Naval Architecture.	
	Term 1.	Term 2.	Term 1.	Term 2.
Junior Year.				
Steam Machinery	...	4	...	4
Electrical Engineering	4	...	...	...
General Machine Design	...	3	...	3
Kinematics and Kinetics	3	...	3	...
Materials of Engineering	2	...	2	...
Physical Laboratory	2	2	...	...
Mechanical Laboratory	3	3	3	3
Naval Architecture	3	3	3	3
Ship-building	...	...	3	3
Shop-work	3	3	3	3
Senior Year.				
Naval Architecture	...	3	4	3
Ship-building, Ship-construction, and Design	...	3	5	2
Marine Engineering	5	3	...	...
Steam Engines, other Motors	5	2	5	2
Physical Laboratory	3	...	2	2
Mechanical Laboratory	3	1	...	...
Electrical Engineering	...	...	4	...
Thesis	...	8	...	8

19. *Other Courses, Cornell.*—Courses are arranged in Railway Mechanical Engineering. There is also a six-year course leading to the two degrees A.B. and M.E. The scheme of this is sufficiently illustrated by the previous case; see section 14 of this chapter.

20. *Equipment and Apparatus, Cornell University.*—At the time of the Commissioner's visit, rapid progress was being made in the development, already excellent and extensive, of the apparatus for teaching and research in the University of Cornell. In the College of Civil Engineering there is a *general laboratory* with a large collection of machines and apparatus. The several special laboratories will be referred to at some length.

21. *Hydraulic Laboratory, Cornell.—The Hydraulic Laboratory* is very complete and on a splendid scale. It contains a large number of appliances, piping, mouth-pieces, and special casting for the determination of co efficients; weirs provided with different forms and heights of notches and orifices; venturi and other water meters; gauges of various kinds with electrical clock-work or other automatic devices for the most accurate measurements either of weights, velocities, pressures, equilibrium, viscosity or heights of heads; various machines or contrivances for determining the flow of liquids in closed and open conduits; several models of water wheels; dynamometers of various kinds; a considerable variety of current meters, some of which record the speed automatically; in others, the revolutions are determined by sound; and still others record, by electrical devices, both the velocity and the direction of the current.

Close to the University buildings there is a stream (Fall Creek). Here there is a curved concrete masonry dam 200 feet long, storing up the water to form the Beebe Lake. The watershed has an area of 120 square miles.

A canal, also built of concrete masonry, and 450 feet long, is located south of the south anchorage of the dam. Its up-stream end is provided with six gates, baffle boarding, and a standard weir to which various devices are attachable for measuring heads, and regulating the amount of air imprisoned under the water

water sheet. The canal is sixteen feet wide and ten feet in depth of water; but the head of water, in some of the experiments, can be made to reach 225 feet. Heads of twenty feet may be utilised within the canal, of eighty feet in the lower part of one of the laboratory buildings; and, for special experiments, a ten-inch pipe supplies water from the reservoir of the University water works, which is one hundred and forty-five feet above the canal. This head can be utilised through a stand-pipe at the bottom of the gorge, below the canal in the large laboratory building. The canal is provided with an electric motor placed on a steel truck running upon rails fastened to the top of its walls; and the speed of the truck can be regulated at pleasure, marking its speed and position on various chronographs.

The water waste of the canal can be regulated by means of valves and terminal weirs until required water velocities are obtained within the canal. At the west end of the canal there is a vertical six foot steel pipe to which water can be admitted either by a lateral channel from the main canal or through a forty-eight inch pipe which taps the dam and Beebe Lake. This subdivision of heads and water volumes enables the performing, simultaneously, class work and experiments, without interfering with the regular conditions of each experiment. The lateral canal is also provided with weirs and gauges upon the removable portion of the walls of this sub-canal. The lower laboratory building is a sightly, solid structure eighty feet long and about eighty feet high, and contains a fifty thousand pound scale and tank. This building shelters and hides from view the steel stand pipe, to the north of which a suitable staircase carries within its well-hole all the necessary piping of iron and glass manometers.

This hydraulic laboratory will soon become the centre of information and reference for the solution of the numberless hydraulic questions awaiting just such opportunities as the conditions of this laboratory offer, and which at present exist nowhere else.

22. *Cement Laboratory, Cornell.*—The Cement Laboratory is provided with automatic machines for the establishment of standard tests. The apparatus of this laboratory has been specially designed, standard conditions being aimed at in all tests. The sifting of cements, moulding, condensing and testing, are performed mechanically. The laboratory contains: three machines of tension tests, three machines for crushing tests ranging from two to two hundred tons, one impact machine, one rattler cylinder of the dimensions recommended by the National Association of Brick Manufacturers, one abrasion machine, and a special machine for determining, automatically, the rate of setting and hardening of cements.

There are also a large number of briquette moulds, scales, plate-glass mixing tables, thermometers for cement test purposes, a Bunsen pump and apparatus for testing the permeability of cements, several sets of apparatus for measuring linear and volume changes during the setting of cements, their specific gravity, and fineness; a large number of scales for various purposes, from chemical balances to a 400,000 pound machine. This laboratory has a water tank capacity for the storage of three thousand briquettes, and many of its appliances are utilised for tests of building materials, such as paving and other bricks, building stone, masonry arches, walls and piers up to twelve feet in height; in addition there are many smaller machines, appliances and tools that are used in common with the equipment of other laboratories. Apparatus designed by the Massachusetts Highway Commission for testing the cementing qualities of roadway materials is also in use.

23. *Geodetic Laboratory, Cornell.*—The Geodetic Laboratory allows of the study of instruments of precision. It contains a sidereal chronometer by Negus, and an accurately-compensated mean-time Howard astronomical clock, which furnishes the standard of time for the University. There are a large number of surveying and portable astronomical instruments for the study of instrumental errors and their constants, and this laboratory is provided with collimators, micrometric level testers, and a reversible Kater pendulum to which noddies may be attached; also a Kew magnetometer and Barrows circle. The manipulation of these instruments, and some of their constants, are obtained in the laboratory, but the magnetic constants and results relating to the earth's magnetism are determined, each year in the field, in connection with the systematic surveys of the Lake region of Central New York, which began in 1874. This room has also several meteorological instruments devised for special purposes., *e.g.*, the study of wind gusts in violent wind, and its horizontal and vertical velocity; but when the velocity exceeds twenty miles per hour another specially-devised machine, modified by E. T. Turner, is then started automatically, and describes upon a rotary cylinder, a curve whose ordinates are proportioned to the wind's velocity for each meter of travel. The machine works so long as the velocity exceeds twenty miles per hour; and an ingenious contrivance prints the time, at intervals of five minutes, upon the endless paper band carried by the revolving cylinder. There are also standard and other mercury barometers, a Draper self-recording barometer, and several other minor instruments bearing upon the studies carried on in the laboratory.

24. *Metric Laboratory, Cornell.*—What is known as the Metric Laboratory is equipped for the comparison of lengths, provided with a line and end measure comparator, and a small Geneva dividing engine. The room is built with hollow, double walls, and the daily range of temperature is less than one degree Fahr. Machines and apparatus for experimentation in such portion of optics, thermodynamics, etc., as form special parts of the educational equipment of the engineer are also to be found in the laboratory. The four-meter line comparator rests on two independent piers, with two micrometer microscopes sliding on a beam, also mounted on independent piers, and the whole comparator is properly covered by a substantial tight case. Projecting handles give motion to the cradle under the microscopes without distributing the internal temperature of the case. A Geneva steel meter bar of the international type forms the standard of length; it has been compared at the United States Coast Survey Office with the International Standard. There is also a Rogers' speculum metal decimeter and four-inch scale, accurately divided and compared, and a brass yard, used as subsidiary length standards. Tonnelot and Baudin thermometers, standardized at the Paris International Bureau, form the basis for temperatures. The room also contains a four-foot comparator for the study of levelling rods, while an iron standard rod, fifty feet long, inlaid on the floor of the main museum, is used as the standard for steel tapes. A Mendenhall half-seconds pendulum, constructed in this college, is mounted upon a pier for determinations of the force of gravity. The pendulum is a reproduction, from patterns loaned by the Coast Survey Office, of the instruments used for the above purposes by the International Association of Geodesists, and contains improvements suggested by the experience with older instruments.

25. *Testing Materials of Construction, Cornell.*—The apparatus in the testing laboratory is very fine. The 400,000-pound testing machine has a clear width of 19 inches between standards, and an effective length of 12 feet for specimens in both tension and compression, the tension grips taking widths up to 8 inches for plates, and 4-inch legs for angles. The capacity for beams and girders is up to 19 inches in width, and to 18 feet in length, the centre load at the latter limit being only 100,000 pounds.

The standard rattler with cast-iron shot for paving brick, and the Deval abrasion machine and Page impact machine for macadam material furnish excellent facilities for the study of roadway materials; while the stone saw and grinding wheel allow of preparing stone specimens with smooth plane beds for the testing machine without danger of injury from the hammer and chisel.

The one-fourth scale steel bridge model furnishes an excellent opportunity for comparing computed stresses with those actually existing in different members of the structure due to various loadings, the stress being found from the measured change in length of the member.

26. *Photographic Laboratory, Cornell.*—The object of the Photographic Laboratory is for reproducing the appearance of tested specimens, for the purposes of the lecture-room, as aid in topographical surveys, and for the distribution, to graduates and purchasers, of reprints of the great collection of progress photographs of engineering structures owned by this College. A revolving transit camera has been added to the collection of photographic appliances, its inventor, Mr. G. W. Parsons, having generously permitted its duplication by the mechanician of the College. This machine is capable of photographing with accuracy through an angle of 360· upon a flexible film 6 inches wide and 60 inches long.

27. *Barnes Astronomical Laboratory, Cornell.* — The Astronomical Laboratory and Training Observatory contains an astronomical transit by Troughton and Simms and one by Fauth, two sidereal clocks and a mean time clock, a 4½-inch Clark equatorial, two large altzamuths reading to seconds by levels and micrometers, and two 3⅜-inch zenith telescopes by Fauth, but modified by the mechanician of the College, besides sextants, chronograph, chronometers, etc.

Students are familiarised with the methods of observing, adjusting instruments, and making reductions and computations for the determination of time, latitude, azimuth, and longitude.

The building of the College of Civil Engineering contains the offices and observatory of the United States Weather Bureau, being the central office for the reception of climate and other data for the State of New York, and for the dissemination of weather forecasts to the region tributary to this centre.

28. *Museums of Civil Engineering, Cornell.*—The following is a brief account of the collections in the museums:—1. Muret collection of models in descriptive geometry and stone-cutting. 2. De Lagrave general and special models in topography and geognosy. 3. Schroeder models in descriptive geometry and stereotomy with over fifty brass and silk transformable models made in the College after the Oliver models. 4. M. Grund collection of bridge and roof details, trusses and masonry structures, such as right, oblique and annular arches and domes, and several intricate models in stone-cutting, supplemented by similar models by Schroeder and other makers. 5. Model railroad bridge of one hundred foot span, one-fourth natural size, and a numerous collection of models of track details. 6. Digeon collection of movable dams, artificial harbours and working models in hydraulic engineering. 7. Working models of water wheels, turbines and other water engines. 8. Several large collections of European and American progress photographs of engineering works, shewing the progress of construction, and many other photographs, blue-prints, models and diagrams. 9. An extensive collection of instruments of precision, such as a Troughton and Simms astronomical transit; a universal instrument by the same makers, reading to single seconds; sextants, astronomical clocks, chronographs, a Negus chronometer; two equatorials, the larger having an objective, by Alvan Clark, four-and-a-half inches in diameter, two large zenith telescopes of improved construction for latitude work, by the eye and photographic methods; spherometers and other instruments, like pier collimators, etc., necessary to complete a most efficient equipment of a training observatory. 10. A geodesic collection, consisting of a four-meter comparator, built at this college of the university; a set of improved pendulums for gravimetric investigations; a secondary base line apparatus made under the direction of the Coast Survey; two new base line bars designed and constructed in the laboratories of this college, and all the portable astronomical and field instruments needed for extensive triangulations, including sounding machines, tachometers, deep water thermometers and heliotropes. 11. Among the usual field instruments, there is nearly every variety of engineers' transits, theodolites, levels, solar and other compasses, omnimeters, tachometers, with a large number of special instruments, such as planimeters, pantographs, elliptographs, arithmometers, computing machines, altazimuths, sextants, telemeters, and altmeters, hypsometers, and self-recording meteorological instruments of all descriptions. 12. A very complete set of all appliances and instruments for making reconnaissance in topographical, hydrographical and mining surveys.

29. *Sibley College and its Equipment.*—The main building of Sibley College is 370 feet long, 50 feet in width, and three stories in height. It contains museums, the reading-room, drawing-rooms, lecture-rooms, large and well lighted auditorium, and the class-rooms and offices of the different professors. The workshops are placed in separate buildings, and consist of a machine shop, a foundry, a blacksmith shop, and a wood-working shop, and include rooms devoted to the storage of tools. Besides these there is an additional building, 150 feet by 40 in dimensions, and two stories in height, occupied by the laboratories of the department of experimental engineering. At the bottom of Fall Creek gorge is the house protecting the turbines which supply the power ordinarily required for driving the machinery of the College, and the electric apparatus for lighting the "campus" and the buildings, and near it, a steam pumping-station, used as a reserve when the power of the hydraulic station is unequal to the demand for water supply. The large engine and dynamo room, containing all the engines and dynamos employed in lighting the University, is adjacent to the shops and beside the boiler-room, in which are placed the 200-h.p. boilers, furnishing steam to these and the experimental engines.

There is a museum at Sibley College of illustrative apparatus, machinery, products of manufacturing, and collections exhibiting processes and methods, new inventions, forms of motors, and other collections of value in the courses of technical instruction, and a large Reuleaux collection of models of kinematic movements.

movements. Besides these are Schroeder and other models exhibiting parts of machinery, the construction of steam engines and other machines, and a large number of samples of machines constructed to illustrate special forms and methods of manufacture. Many of these machines and tools have been made in the University shops.

A special museum building has been erected for the School of Railway Mechanical Engineering, in which is an important and growing collection of railway appliances, either new, or shewing failures in service, or tested in Sibley laboratories.

The workshops are supplied with every needed kind of machine or tool, including lathes, and hand and bench tools sufficient to meet the wants of two hundred and fifty students of the first year in wood-working; in the foundry and forge, all needed tools for a class of two hundred in the second year; in the machine shop, machine tools from the best builders, and a great variety of special and hand tools, which are sufficient for a class of one hundred and fifty in the third year, and as many seniors and graduate students. Many of the machine and hand tools are the product of the College workshops.

30. *Mechanical Laboratories, Sibley College.*—The mechanical laboratories are supplied with the apparatus for testing materials, and for experimental work in the determination of the power and efficiency of heat, and hydraulic motors; and have facilities for operating and testing the steam and hydraulic power plant employed in driving the machinery of the establishment, boiler-testing plant and instruments; and with strength of metals, including machines of 50, 100, and 150 tons capacity; and one 60,000 and one 200,000 pound Emery machine, of great accuracy and delicacy. About thirty steam engines, air, oil, and gas engines; fourteen dynamometers, ten lubricant-testing machines, about fifty standard pressure gauges and an equally numerous collection of steam-engine indicators, together with other apparatus and instruments of precision, employed by the engineer in such researches as he is, in practice, called upon to make, are collected here. A large "plant" is employed for experimental purposes and for research. All the motors of the University, and its boilers, amounting to 1000 horse-power, are available for test trials. The steam-engines are set up, with the heavy lighting dynamos, adjacent to the boilers; among them a 200 h.p. "experimental" engine, and several of smaller power, including 150 h.p. steam-turbine with dynamo attached, and a 20 h.p. quadruple expansion experimental engine and steam boiler, designed and built by students, and arranged to use with steam at 500 pounds pressure, exhibiting an efficiency without precedent at its date.

The laboratories are divided into departments for instruction and investigation. The department of steam engineering possesses one triple expansion Corliss engine, one triple expansion slide valve engine of 60 h.p., one quadruple expansion engine, and numerous examples of simple and compound engines and pumps; one Parsons' steam turbine of 200 h.p. and one De Laval Wilcox water tube boiler fitted with superheating apparatus, one Heine water tube boiler, one Roberts' water tube boiler, one special water tube boiler for 1000 pounds steam pressure, and several examples of shell boilers; it also contains several surface condensers, heaters, traps and other accessories of a steam-power plant; it also contains all apparatus necessary for the complete tests of steam-engines and other motors, including about eighty indicators and a large collection of gauges, thermometers, reducing motions, etc. The department of internal-combustion motors includes a very complete collection of hot-air engines, gas and oil engines of various types, which are sufficient to illustrate all the principal improvements in this art, which have been made since the earliest use of a successful gas engine; altogether, the Department has thirteen working motors of this type, with all the facilities required for testing. The department of refrigeration and air compression includes one complete refrigerating plant of small size, with all apparatus for testing, several air-compressors of both the single and two-stage type; several fans and blowers, with apparatus for testing; one complete set of air-brake apparatus, a rock-drill, and a number of compressed-air tools, also a meter for the measurement of compressed air. The department of lubrication and friction contains a complete assortment of apparatus for the measurement of the friction, and the testing of lubricants, including eight oil-testing machines; and apparatus for the measurement of viscosity, and other physical properties of oil. It also contains a large collection of transmission and absorption dynamometers for the measurement of power. The department of hydraulic machinery possesses a number of hydraulic motors, pumps, hydraulic rams, and apparatus for testing the same. It also contains a number of small weirs, nozzles, and other apparatus for measuring the flow of water.

31. *Laboratories of Electrical Engineering, Cornell.*—The equipment is adopted to the giving of experimental lectures, to laboratory practice, to complete plant testing to standardization and to original investigation. In addition to the usual complement of apparatus for demonstration, the lecture equipment includes an air-insulated, high pressure transformer with necessary regulators for subjecting insulators and insulating material to alternating pressures up to 80,000 volts. This may be supplemented by additional transformers for raising the pressure still higher. A 30,000 volt inductorium provides current for wireless telegraphy. Large cathode ray tubes, supplied from a special multiple plate, power driven static machine, are used for the demonstration of laternating current phænomena. All the standard equipment, as well as many pieces of specially designed apparatus are employed to shew to the classes the operation of the principal laws applied in electrical engineering. Exhibits of apparatus, such as street railway car controllers, rail sections, insulating and line material, etc., are provided in profusion. This list includes a complete outfit for exhibiting in actual operation the multiple unit system of electric car control. The Laboratory apparatus comprises a full complement of alternating and direct current machinery of all kinds. Recent additions include a two-phase generator of excellent design, single and polyphase induction motors, a rotary convertor and transformers, switch-boards, and auxiliaries necessary for exercises in polyphase practice. There are, in addition, many single-phase machines suitable for operation as generators or as synchronous motors. A large variety of direct current dynamos and motors, suitably mounted for testing, cover the field of direct current machinery. Arc lamps, a welding machine, photometers, and many other special devices are included in the equipment. A De Laval steam turbine, geared to a double current generator, a direct connected marine set and circuit breakers, switches, water rheostats, and other auxiliaries are in use for plant test experiments. The plant testing is done largely outside the College buildings, and for this purpose a large variety of ammeters, voltmeters, wattmeters, and other instruments are maintained in adjustment at a high standard of accuracy. The instruments have capacity great enough for testing the largest

largest power plants. Special facilities are provided for the standardization of all electrical apparatus. Board of Trade and Reichanstalt standards of resistance with large current carrying capacity, potentiometers and galvanometers, and reference standards of electro motive force are among the facilities provided for this purpose. The College possesses a Parsons steam turbo-alternator, 150 kilowatt capacity, provided with all the apparatus necessary for complete study and investigation of this class of machinery. A number of lighting alternators, and direct current power and lighting generators are available for the same purpose. A remarkable set of generators recently installed produces a pressure of 14,000 volts direct current by connecting in series, and most carefully insulating twenty-four 550-volt dynamos. The pressure thus available opens up a wide field of investigation. In addition to the apparatus at the University, the students may observe in operation a modern three-phase power transmission in the local power and lighting service. Large direct connected generators, rotaries, constant current regulators and induction motors, as well as the lighting and railway system, are convenient for inspection.

32. *Sheffield Scientific School, Yale University.*—The Sheffield Scientific School, commenced in 1847, has its present constitution by an Act of the State Legislature of 1892. Entrance to the Freshman Class cannot take place earlier than 16. The conditions of admission are high, and include :—

(1) English Grammar ; and (2, 3) Literature ; (4) English History ; (5) History United States, or Roman or Greek History ; (6) Latin Grammar and Composition ; (7) Cæsar or Nepos ; (8) Virgil or Cicero ; (9) German or French ; (10) El. Algebra ; (11) Adv. Algebra ; (12) Plane Geometry ; (13) Solid and Spherical Geometry ; (14) Plane Trigonometry ; (15) Logarithms ; (16) Botany or Chemistry or Physics.

But this examination can be divided between two successive years
The courses of instruction are :—

(1) In Chemistry.
(2) In Chemistry, prepatory to Metallurgy.
(3) In Civil Engineering.
(4) In Mechanical Engineering.
(5) In Electrical Engineering.
(6) In Municipal and Sanitary Engineering
(7) In Engineering, preparatory to Mining.
(8) In Natural History.
(9) In Natural History.
(10) In Mineralogy and other studies, preparatory to Geology.
(11) In Biology, preparatory to Medical studies.
(12) In Select studies, preparatory to other higher studies.
(13) In Agriculture.
(14) In studies preparatory to the study of Forestry.

The Freshman year is introductory to all courses. The complete courses leading to graduation are four years. Persons who complete their under-graduate courses at Yale or elsewhere may get the Bachelor of Philosophy in 1–3 years ; or, in two years of additional engineering study, may get that of Civil Engineer, or Mechanical Engineer. Or they may become Masters of Science or Doctors of Philosophy.

Graduate Courses are given in—

(1) Meteorology, Forest Physiography, and Physical Geography as related to History
(2) Mechanical Engineering.
(3) English Literature.
(4) Zoology.
(5) General Biology, Comparative Anatomy, Embryology, and Cytology.
(6) Civil Engineering.
(7) Physics and Guidance in Laboratory Work.
(8) Applied Economics.
(9) Physiological Chemistry, Physiology, and Experimental Toxicology.
(10) Analytical Chemistry, Inorganic Chemistry, and Metallurgy.
(11) Chemical Physics.
(12) Mineralogy and Crystallography.
(13) Physical Geology and Petrology.
(14) Invertebrate Palæontology.
(15) Old High German.
(16) Higher Analysis and Advanced Analytical Geometry.
(17) Structural and Systematic Botany, with special reference to the Microscopic Anatomy of Phanerogamous and Cryptogamous Plants.
(18) Municipal and Sanitary Engineering.
(19) Organic Chemistry.
(20) Physico-Chemical Measurements and Electro-Chemistry.
(21) Proximate Organic Analysis, with special reference to the detection of Adulteration in animal and vegetable food-products.
(22) Analytical Mechanics.
(23) German.
(24) Phonetics of Modern French.
(25) History.
(26) Partial Differential Equations.
(27) Bacteriology and Hygiene.
(28) Plant Physiology.

The

The Freshman Year is introductory to all courses, and is as follows :—

First Term.—German or French, 3 hours per week. Plane analytical geometry, 3. Physics, recitations, 2; experimental lectures, 2. Chemistry, recitations, 2; lectures and laboratory practice, 3. History of the English language, 2. Freehand Drawing, practical lessons in the Art School, 3 hours.

Second Term.—German or French, physics and chemistry are the same as above. Plane analytical geometry, continued, 3 hours per week first half of term; analytic geometry of space or calculcus, 3, second half of term. English, Shakespeare, Byron, Tennyson and Browning, 2. Principles of orthographic, isometric, and oblique projection; intersection and development of surfaces; outlines of shadows; shading and tinting; elements of perspective; examples of various applications of instrumental drawing, 3 hours.

33. *Course in Chemistry, Yale.*—In this and the following courses abbreviations will be used, viz., L for lectures, R, recitations, P, laboratory practice, B, blowpipe practice or analysis, and F, for field-work The following is the course in Chemistry.

Junior Year.

First Term.—Organic chemistry : L and R, 2 hours per week. Qualitative analysis : R and L, 4; P, 15. Mineralogy : B, 4. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Organic chemistry : P, 15 hours for 4 weeks; L and R, 2. Quantitative analysis (gravimetric) : P after 4 weeks, 15 hours; R, 2, Mineralogy : B, 3; 1 in crystallography and descriptive mineralogy, 2. English composition : 1. German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Organic chemistry : R and L, 2 hours per week. General and theoretical chemistry, R, 3 Quantitative analysis (volumetric) : 15 hours. Geology, R, 3 hours. French or German, 3 hours. Military science, L, 1 hour.

Second Term.—Physical chemistry, R, 3 hours per week. Inorganic preparations, followed by organic preparations, P, 15 hours; R, 1 hour. (Optional : Proximate analysis of vegetable and animal products, physico-chemical measurements, sanitary water analysis, 6 hours, for part of term.) Metallurgy, assaying, and gas analysis : 3 hours. Geology, 3 hours. Mineralogy (optional). Elementary petrology, L (optional), 1 hour. French or German, 3 hours.

34. *Course in Chemistry Preparatory to Metallurgy, Yale.*—The following are the details of the course :—

Junior Year.

First Term.—Surveying : F, first three weeks in September. Qualitative chemical analysis : P, 15 hours per week. Qualitative analysis : L and R, 4 hours. Determinative mineralogy, 3 hours. Descriptive geometry, 3 hours. French, 3 hours. German, 3 hours. English composition, 1 hour.

Second Term.—Quantitative analysis (gravimetric) : P, 15 hours per week. Quantitative analysis : L, 2 hours. Determinative mineralogy, 3 hours. Crystallography and descriptive mineralogy, 2 hours. Descriptive geometry and drawing, 3 hours. French, 3 hours. German, 3 hours. English composition, 1 hour.

Senior Year.

First Term.—Volumetric chemical analysis, 15 hours per week. General chemistry, 3 hours. Geology, 3 hours. Mineralogy, 6 hours. French or German, 3 hours. Military science : L, 1 hour.

Second Term.—Inorganic preparations, followed by metallurgic analysis, 15 hours per week. Metallurgy, followed by assaying and gas analysis, 3 hours. Zoology, followed by geology, 3 hours. Petrology, followed by ore deposits, 1 hour. Mineralogy (optional). Physical and electrical chemistry, 3 hours. French or German, 3 hours.

35. *Course in Civil Engineering, Yale.*—The following is the course in civil engineering :—

Junior Year.

First Term.—F, first three weeks in September; mapping, 12 hours until November. Differential calculus, with applications to geometry and analysis, 5 hours. Drawing : Bridge details, 2 hours. Descriptive geometry, 6 hours after November 1st. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Integral calculus with applications to geometry, 5 hours per week first half-term. Theoretical mechanics, 5 hours per week second half-term. Drawing : Bridge details, 2 hours. Spherical trigonometry, 2 hours for first half-term. Railway engineering : Curves, earthwork, etc. 2 hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Field Engineering : location of line of railroad; three weeks in June and July. Office-work; mapping; calculation of earthwork; L on economic location; 6 hours first half term. Railroad economics : L, 2 hours. Mechanics : statics, 4 hours. Civil engineering : Mechanics applied to engineering; strength of materials; bridges and roofs, 4 hours. Geology : R, 3 hours. Mineralogy : B, 6 hours. French or German, 3 hours. Military science, L, 1 hour.

Second Term.—Civil engineering : Bridges and roofs; building materials; stability of arches and walls; foundations, 4 hours per week. Mechanics : Applied mechanics, 4 hours first half-term. Drawing : Designing; practical problems; specifications and estimates; 12 hours after February 10th. Forest hydrography; L (optional) 4 to 6 hours in number during second half-term. Astronomy : Practical astronomy, with F; adjustment of observations; theory of least squares, 3 hours. Geology, 3 hours until February 10th. Elementary petrology, L (optional) 1 hour. French or German, 3 hours.

36.

36. *Course in Mechanical Engineering, Yale.*—The course in mechanical engineering is as follows :—

Junior Year.

First Term.—Differential calculus, with applications to geometry, and analysis, 5 hours per week. Thermodynamics, 2 hours. Principles of mechanism : Applied kinematics, 2 hours. Drawing : Descriptive geometry, 3 hours English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Integral calculus, with applications to geometry, 5 hours per week first half-term ; theoretical mechanics, 5 hours second half-term. Shop visiting : Study of machine details and tools, $1\frac{3}{4}$ hours. Thermodynamics until about April, afterwards applied mechanics, 2 hours. Drawing : Machine elements and mechanical movements, 3 hours. English composition, 1 hour ; German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Mechanics, 3 hours per week. Study of heat engines and the steam boiler, 4 hours per week. Strength of materials, 2 hours. Machine designing : Practical exercises in designing machine details and simple machines, 8 hours ; visits of inspection ; examination of machinery in operation ; reports of visits. French or German, 3 hours. B (optional), 3 hours. Military science : L, 1 hour.

Second Term.—Mechanics, continued, 3 hours per week. Study of heat engines and the steam boiler, continued until about March, 3 hours. Stresses in structures, 3 hours after February. Hydrostatics and hydrodynamics, including resistance of ships and theory of water-wheels and turbines, 3 hours. Machine designing, continued, 8 hours. French or German, 3 hours. Mineralogy (optional), 3 hours.

37. *Course in Electrical Engineering, Yale.*—The following will give an indication of the course in electrical engineering :—

Junior Year.

First Term.—Differential calculus, with applications to geometry and analysis, 5 hours per week. Theory of heat, 2 hours. Descriptive geometry, 3 hours. Mechanism, 2 hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Integral calculus, with applications to geometry, 5 hours per week first half-term. Theoretical mechanics, 5 hours second half-term. Theory of electricity, 2 hours. Descriptive geometry and drawing, 3 hours. Analytical mechanics, 2 hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Theory of observations and theory of instruments, 5 hours per week ; P, 6 hours. Machine designing, 6 hours. Steam engine, 2 hours. Shop visiting, 2 hours. French or German, 3 hours. Military science : L, 1 hour.

Second Term.—Theory of electricity, 5 hours per week ; P, 6 hours. Dynamo construction, 2 hours. Machine designing, 6 hours. Steam engine, 2 hours. French or German, 3 hours.

38. *Course in Municipal and Sanitary Engineering, Yale.*—The following is the programme of the Course :—

Junior Year.

First Term.—Surveying : F., first three weeks in September. Mapping, 12 hours per week until November. Differential calculus, with applications to geometry, kinematics, and analysis, 5 hours. Drawing : Bridge details, 2 hours. Descriptive geometry, 6 hours, after November 1st. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Integral calculus, with applications to geometry, 5 hours per week first half-term. Theoretical mechanics, 5 hours second half-term. Drawing : Bridge details, 2 hours first half-term. Masonry construction, 2 hours. Cement testing, 2 hours first half-term. Spherical trigonometry, 2 hours first half-term. Railway engineering, 4 hours second half-term. English composition, 1 hour. German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Field engineering : Topographical and hydrographical surveying, three weeks in June and July. Office work : Calculations and mapping, 6 hours until November 10th. Water supply engineering, 3 hours. Mechanics, 4 hours. Stresses, bridges, and roofs, 3 hours. Chemistry, 6 hours. Roads and pavements, 1 hour. Physical geology, 3 hours. German or French, 3 hours. Military science : L, 1 hour.

Second Term.—Hydraulics, 3 hours per week. Strength of materials, 3 hours to February 10th. Designing : Roofs and bridges, 5 hours after February 10th. Sewer design and construction, 4 hours first half-term. Chemistry : Water analysis, 6 hours first half-term. Bacteriology, 6 hours second half-term. Sewage disposal, 3 hours second half-term. Practical astronomy and adjustment of observations, 3 hours second half-term. Interpretation of water analysis, 1 hour second half-term. German or French, 3 hours.

39. *Course in Engineering Preparatory to Mining, Yale.*—The following are the details of this course :—

Junior Year.

First Term.—Surveying: F, first 3 weeks in September. Differential calculus, 5 hours per week. Thermodynamics, 2 hours. Descriptive geometry, $1\frac{1}{2}$ hours. Determinative mineralogy: P, 3 hours, to count as $1\frac{1}{2}$ hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Integral calculus, 5 hours per week first half-term. Theoretical mechanics, 5 hours second half-term. Thermodynamics, 2 hours first half-term. Descriptive geometry and drawing, 3 hours first half-term. Determinative mineralogy, 3 hours. Crystallography and descriptive mineralogy, 2 hours. English composition, 1 hour. Applied mechanics, 2 hours second half-term. Drawing, 3 hours second half-term. French, 3 hours. German, 3 hours.

Senior Year.

First Term.—F, three weeks in June and July. Mapping, first six weeks of term, $2\frac{1}{2}$ hours. Mechanics, 3 hours. Steam engine, 4 hours. Strength of materials, 2 hours. Machine designing, 2 hours first six weeks of term, afterwards 4 hours. Geology, 3 hours. French or German, 3 hours. Military Science, L., 1 hour.

Second Term.—Mechanics, 3 hours per week. Steam engine, 3 hours first half-term. Hydraulics, 3 hours. Machine designing, 4 hours. Zoology and geology 3 hours first half-term. Stresses in structures, 3 hours second half-term. Geology, 3 hours second half term. Petrology and ore deposits, 1 hour. French or German, 3 hours.

40. *Course in Natural History, Yale.*—The details of this course are as follows :—Either zoology or botany may be made the principal laboratory study, some attention in each case being directed to the other branches of Natural History.

Junior Year.

First Term.—Organic chemistry: L and R, 2 hours per week. Qualitative analysis: R and L, 4 hours. P, 15 hours. Mineralogy: B, 3 hours. Physical geography, 2 hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Zoology: P, 6 to 12 hours per week; R and L, excursions (land and marine). Botany: P, in a study of the morphology of the lower cryptogamous plants, 3 hours during spring half-term. Physiology: R and L, 2 hours. Embryology: L. Mineralogy: B, 4 hours. Physical geography: 2 hours, during winter half-term. English composition, 1 hour. German, 3 hours. French, 3 hours.

Senior Year.

First Term.—Geology: R, 3 hours per week. Zoology: P, 8 to 15 hours; L, 2; R, 3; excursions. Botany: P, in the study of the morphology of the higher cryptogamous and phanerogamous plants, 6. Meteorology: L, 2. French or German, 3. Military science: L, 1 hour.

Second Term.—Geology: R, 3 hours per week.. Anatomy of vertebrates, 2. Zoology: P, 8 to 15 hours; R, 2; L, 2. Botany: Herbarium studies, in any desired line; botanical literature; essays in descriptive botany. Sanitary science, laws of heredity, and principles of breeding; L, French or German, 3 hours.

Besides the regular course of recitations and lectures on structural and systematic zoology and botany, and on special subjects, students are taught in the laboratories to prepare, arrange, and identify collections, to prepare sections and other microscopic objects, to take dissections and drawings, to pursue special investigations, and when sufficiently advanced, to describe genera and species in the language of science. For these purposes, large collections in zoology and botany belonging to to the University are available.

41. *Course in Mineralogy and other studies preparatory to Geology.*—The following is the Course. As the Junior Year is identical with that in Chemistry, it is unnecessary to outline it :—

Senior Year.

First Term.—During the first term the course is identical with that in Chemistry.

Second Term.—Crystallography, including the use of the reflecting goniometer, and the drawing and calculation of crystals. Optical properties of crystals and the use of the polarizing microscope: P, 20 hours per week. Mineralogy: L, 2 hours. General chemistry, metallurgy, assaying, and gas analysis, 2 hours. Elementary petrology: L, 1 hour. Geology, 3 hours. French or German, 3 hours.

This course, however, is open only to students who have maintained a high scholarship standing in the chemical studies of Junior year, since only a limited number can be accommodated.

42. *Course in Biology preparatory to Medical Studies, Yale.*—The following is the Course :—

Junior Year.

First Term.—Organic chemistry: L and R, 2 hours per week. Qualitative analysis: P, 15 hours; R and L, 4 hours. Mineralogy: B, 3 hours. English composition, 1 hour. German, 3 hours. French, 3 hours.

Second Term.—Organic chemistry, continued, 15 hours for 4 weeks and 2 hours for rest of term. Comparative anatomy and general biology: L, R and P, 15 hours. Physiology: R, with demonstrations, 2 hours, commencing the fifth week of the term. Laboratory physics, 4 hours during spring half-term. Mineralogy, continued through winter half-term, 4 hours. Botany: P in a study of the morphology of the lower cryptogamous plants, 3 hours, during spring half-term. English composition, 1 hour. French, 3 hours. German, 3 hours.

Senior

Senior Year.

First Term.—Physiological chemistry and physiology: R and L, 1 hour per week; P with demonstrations, 13 hours. Organic chemistry: L and R, 2 hours. Zoology: L, 2 hours. Botany: P in the study of the morphology of the higher cryptogamous and phanerogamous plants, 6 hours. Geology: R, 3 hours. French or German, 3 hours. Military science: L, 1 hour.

Second Term.—Physiological chemistry and physio'ogy: Illustrative lectures and recitations, 4 hours per week; P and demonstrations, 13 hours. Experimental toxicology: L, 3 hours during spring half-term. Geology: R, 3 hours. Morphology and embryology of vertebrates: L and demonstrations, 6 hours during winter half-term. Zoology: L work in the dissection of typical animal forms, 4 hours. Laws of heredity and principles of breeding: L, 2 hours during winter half-term. Sanitary science: L, 2 hours during spring half-term. French or German, 3 hours.

43. *Course in Select Studies preparatory to other Higher Studies.*—The following is the programme of study for this course:—

Junior Year.

First Term.—Physical geography: R and L, 4 hours per week. Early English, 2 hours. Anthropology: 2 hours. History: Mediæval, 3 hours; English composition, 1 hour; French, 3 hours; German, 3 hours.

Senior Year.

First Term. Geology: R, 3 hours per week; excursions. Meteorology: L, 2 hours. English: Shakespeare, 3 hours. Economics, 5 hours. Constitutional history of the United States, 3 hours. French or German, 3 hours. Military science: L, 1 hour.

Second Term.—Zoology, 3 hours per week during Winter half-term, to be followed by historical geology; 3 hours during the remainder of the year. Heredity: L, 2 hours during Winter half-term. Sanitary science: L, 2 hours during Spring half-term. Economics: R, exercises, and L, 5 hours during first part of Winter half-term, followed by economics, 2 hours, and political science, 3 hours, during the remainder of the year. Constitutional history of the United States: 3 hours during Winter half-term, and 2 hours during Spring half-term. English: Shakespeare, Milton, Dryden, Pope, Gray, and later authors, 3 hours during Winter half-term, 4 hours during Spring half-term. French or German, 3 hours.

44. *Course in Agriculture, Yale.*— The following is the course in agriculture:—

Junior Year.

This course is identical with that in chemistry, except that in the second term lectures in crystallography and descriptive mineralogy are omitted, and in the Spring half-term botany is substituted for determinative mineralogy.

Senior Year.

First Term.—Agriculture: R, 2 hours per week. Agricultural chemistry (chemical physiology of vegetation): L, 2 hours. Geology: R, 3 hours. Zoology: L, 2 hours. Meteorology: L, 2 hours. Botany: P, 5 hours. French or German, 3 hours. Military science: L, 1 hour.

Second Term.—Agriculture: R or L, 2 hours per week. Agricultural chemistry: L, 2 hours. Physiology: R and L, 2 hours. Geology: R, 3 hours. Zoology—continued, 2 hours. Heredity and stock-breeding: L, 2 hours during Winter half-term. Sanitary Science and public health: L, 2 hours during Spring half-term. French or German, 3 hours.

45. *Course in studies preparatory to the Study of Forestry, Yale.*—The following gives an indication of the course:—

Junior Year.

First Term.—Surveying: F, first 3 weeks in September. Mapping: 12 hours until November. Outlines of Forestry: L, 3 hours. Mineralogy: P, 4 hours. Economics, 5 hours. German, 3 hours. French, 3 hours. English composition, 1 hour.

Second Term.—Strength of materials, 2 hours per week first half-term. Spherical trigonometry, 2 hours first half-term. Economics, 5 hours first half-term, and 2 hours second half-term. Political science, 3 hours during second half-term. Practical astronomy, with F, etc., 4 hours during second half-term. Botany of flowering plants, P, 4 hours. German, 3 hours. French, 3 hours. English composition, 1 hour.

Senior Year.

First Term.—Meteorology: L, 2 hours per week. Physical geology: R, 3 hours. Forest mensuration: L and R, 2 hours. Field work. General morphology of plants: P and informal L, 4 hours. Sylviculture: L, 3 hours. F. Forest botany: L and P, 2 to 4 hours. French or German, 3 hours. Military science: L, 1 hour.

Second Term.—Physical geology: R, for 8 weeks of first half-term, 3 hours per week. General morphology of plants: P, excursions and informal lectures, 4 hours. Forest botany: L, P, and excursions, 2 to 4 hours. Sylviculture: L, 3 hours. F. Elementary petrology: L, 1 hour, first half-term. Origin and nature of soils: L, 1 hour, second half-term. Forest physiography and meteorology: L, 4 hours during first half-term. State and national forestry: 4 to 6 special lectures during first half-term. Forest hydrography: 4 to 6 special lectures during second half-term. Forest mensuration: L and R, 2 hours; F, first half of term. German or French, 3 hours.

In second-half term there is outside field work in Forestry and Thesis work.

46.

46. *General Remarks.*—It will be recognised that work at Yale is entered upon after fairly thorough preparation. As is well known, the teaching has a high reputation, and the laboratories at the time of the Commissioners' visit were well equipped, and were rapidly being added to. The Sheffield Scientific School has a world-wide reputation.

A word or two may be said in regard to the equipment of the mathematical laboratory. Besides a good equipment of drawing instruments, and everything necessary for constructing mathematical models, it is furnished with an extensive collection of models. Beside the plaster and thread models of Brill and Schilling, there are a large number for the teaching of solid geometry, theory of equations, kinematical principles, tortuous curves, ruled surfaces, etc. The other laboratories are excellently furnished both for instruction and research.

The Sheffield Scientific School Library possesses about 10,000 volumes.

47. *The Towne Scientific School, University of Pennsylvania.* — The courses of the Towne Scientific School, which is the technical side of the University of Pennsylvania, and is situated in Philadelphia, are:—

I. Architecture (three courses, and course in Interior decoration).
II. Science and Technology (several courses).
III. Mechanical Engineering.
IV. Electrical Engineering.
V Civil Engineering.
VI. Chemistry.
VII. Chemical Engineering.

Tuition fees vary from 50 to 200 dollars per annum. Admission is by examination or by possessing of certificates or diplomas from public high schools.

The various courses are briefly indicated in the sections following.

48. *Courses in Architecture, Pennsylvania.*—The undergraduate course is 4 years, leading to the Bachelor of Sciences in Architecture. The course is as follows:—

PROGRAMME OF ARCHITECTURAL COURSE, PENNSYLVANIA UNIVERSITY.

Subjects.	Hours per Week. Term 1.	Hours per Week. Term 2.
Freshman Year.		
Architectural Drawing	12	...
Elements of Architecture—		
Lectures	2	2
Drawing	8	11
Graphics	6	...
Shades and Shadows	6	...
Perspective	...	3
English Composition	2	2
English Language	1	1
French *or*	3	3
German	3	3
Algebra	4	...
Trigonometry	...	4
Chemistry	4	4
Sophomore Year.		
Rendering and Order Problems ...	8	...
Design	...	12
Freehand Drawing	...	6
Architectural History—		
Ancient	6	...
Renaissance...	...	6
Summer Work	...	...
English Composition	1	1
Modern Novelists	2	...
Modern Essayists	...	2
French *or*	5	5
German	5	5
Analytic Geometry	4	...
Physics	2	2
Junior Year.		
Design	17	25
Freehand Drawing—		
Historic Ornament... ...	2	2
Antique	2	2
Water-colour Drawing	...	3
Pen and Ink Rendering	2	2
Architectural History, Mediæval	6	...
Mechanics of Materials	3	...
Graphic Statics	...	3
Building Construction	1	1
Sanitary Engineering of Buildings: Hygiene ... ... / Heating and Ventilation / Plumbing and Drainage	1	1
Summer Work	...	...
Senior Year.		
Design	32	...
Thesis Design	...	32
Historic Ornament; Design ...	9	9
Freehand Drawing; Life ...	4	4
Water-colour Rendering... ...	3	3
Pen and Ink Rendering	2	2
History of Painting	1	1
Building Construction	1	1
Special Lectures	1	1
Summer Work	...	...
There is a Graduate Year as follows:—		
Design	30	30
Freehand Drawing; Life... ...	4	4
Water-colour Rendering... ...	5	5
History of Architecture; Research and Conference	2	2
Fine Arts; History or Theory; Research and Conference ...	1	1

Besides the above, there is a two-year special course for candidates of at least 18 years of age, who have already been practising two years with an architect.

PROGRAMME

PROGRAMME OF TWO-YEAR COURSE IN ARCHITECTURE.

Subject.	First Year.	
	Term 1.	Term 2.
Elements of Architecture—		
Lectures	2	...
Drawing	10	...
Rendering and Order Problems ...	...	14
Design	...	14
Shades and Shadows	3	...
Perspective	...	3
Freehand Drawing—		
Historic Ornament... ...	2	2
Antique	2	2
Water-colour Drawing	3	3
Pen and Ink Rendering	2	2
Architectural History—		
Ancient	6	...
Renaissance...	...	6
Mechanics of Materials	3	...
Graphic Statics	...	3
Building Construction	1	1
Sanitary Engineering of Buildings:		
Hygiene		
Heating and Ventilation	1	1
Plumbing and Drainage		

Subject.	Second Year.	
	Term 1.	Term 2.
Design; Junior	27	..
Design; First Term Senior ...	...	36
Historic Ornament; Design ...	9	9
Freehand Drawing; Life ...	4	4
Water-colour Rendering	3	3
Architectural History; Mediæval	6	...
Building Construction	1	1
Special Lectures	1	1
Summer Work	...	...

A Special Course in Interior Decoration is given, covering three years.

PROGRAMME OF THREE-YEAR COURSE IN INTERIOR DECORATION.

Subject.	First Year.		Second Year.		Third Year.	
	Term 1.	Term 2.	Term 1.	Term 2.	Term 1.	Term 2.
Composition of Ornament	27	19	...	...	...	...
Freehand Drawing	4	4	4	4	4	4
Water Colour Drawing...	3	3	3	3	3	3
Colour Study	...	3	...	3	...	...
Perspective	...	3	...	...	...	...
Decorative Design or Furniture Design	...	...	25	22	...	...
Interior Design or Furniture Design	...	...	...	...	27	27
Pen and Ink rendering...	...	...	2	2	...	...
Substitute Work may replace Composition of Ornament with equal number of hours in first year.						
Architectural Drawing...	12	...	...	...	...	...
Elements of Architecture	2	2	...	...	...	...
Drawing (Architectural Elements)	8	11	...	...	...	...
Graphics	6	...	...	...	...	...
Shades and Shadows	6	...	...	...	...	...

49.—*Courses in Science and Technology, Pennsylvania.*—These courses are of five years' duration, two being devoted to general literary and scientific study, and three to technical training in (i) Chemistry, (ii) Civil Engineering, (iii) Mechanical Engineering. The Freshman and Sophomore classes are common to the three courses, and are as follows:—

General Courses in Science and Technology, University of Pennsylvania.

Subject.	Freshman Year.		Sophomore Year.	
	Term 1.	Term 2.	Term 1.	Term 2.
English Composition	2	2	1	1
English Language and Analysis	1	1	...	...
Public Speaking	1	1	...	...
Modern Novelists and Essayists	...	...	2	2
Algebra: Differential Calculus	4	...	...	4
Trigonometry: Projections[1]	...	4	2	...
Analytic Geometry: Analytical Mechanics[1]	...	...	4	2
Descriptive Geometry[1]	...	...	...	3
General Chemistry: Qualitative Chemistry	4	4	4	4
Mechanical Drawing	4	4	...	...
Freehand Lettering	2	...	...	...
Massphysics, Energy: Sound, Heat	...	...	2	2
American or European History	2	2	...	...
German or French	3	3	3	3
Scientific Reading in German or French	...	...	2	2

The details of the various developments are given in the sections next following:—

50. *Courses in Mechanical Engineering, Pennsylvania.*—There are two series of courses, viz., the junior, senior and post-senior years following on the preceding and the ordinary four-year course. The B.S. is conferred at the end of the senior year and the M.S. at the end of the post-senior year.

The detailed development is as follows:—

Programme in Mechanical Engineering, Pennsylvania University.

Subjects.	Junior Year.		Subjects.	Senior Year.		Subjects.	Post-senior Year.	
	Term 1.	Term 2.		Term 1.	Term 2.		Term 1.	Term 2.
Mechanical Drawing	3	3	Machine Sketching ...	3	3	Hydrodynamics ...	2	2
Steam Engine ...	...	2	Kinematic	3	...	Boiler Calculations ...	2	...
Statics	2	2	Advanced Shop-work...	6	6	Boiler Design	...	2
Hydraulics ...	...	3	Engine Calculations ...	2	...	Appd. Thermodynamics	2	...
Shop-work ...	6	3	Engine Design ...	...	2	Adv. Mech. Laboratory	6	3
Altern. Currents ...	...	2	Graphics	4	...	Machine Design ...	3	3
English Composition	1	1	Thermodynamics ...	...	3	Shop Visits	3	...
English Literature	2	2	Mechanical Laboratory	3	...	Thesis	...	9
German or French	2	2	Electro-dynamics ...	2	2	Adv. Elect. Laboratory	3	...
Calculus	4	...	Electrical Laboratory...	...	3	Elect. Measurements ...	2	...
Physics	3	3	Economics	2	2	Dynamo Design ...	...	2
Analytic Mechanics	2	...	Physical Measurements	4	4	Alt. Curr. Applications	1	1
			Metallurgy	...	2	Electr. and Magnetism	...	3
						Electr. Testing ...	6	3
						Business Law ...	1	1
						Specifications ...	...	1

[1] For students who intend to take Engineering: those who intend to take Chemistry omit, and take additional hours in the chemical laboratory.

The

The four-year course is as follows :—

Subjects.	Freshman Year.		Sophomore Year.	
	Term 1.	Term 2.	Term 1.	Term 2.
Descriptive Geometry	2	2	...	...
Elementary Drawing : Mechanical Drawing	2	2	3	3
Steam Engine	...	2	...	...
Shop-work : Advanced Shop-work	6	3	6	6
English Composition and Literature	3	3	1	2
French or German	3	3	3	3
Trigonometry : Analytical Geometry	4	...	4	...
Algebra : Calculus	...	4	...	4
Physics	2	2	3	3
Chemistry—General : Qualitative	4	4	4	4
Analytical Mechanics	...	...	...	2

Subjects.	Junior Year.		Subjects.	Senior Year.	
	Term 1.	Term 2.		Term 1.	Term 2.
Machine Sketching	3	3	Hydrodynamics	2	2
Statics	2	2	Engine Calculations...	2	...
Hydraulics	...	3	Engine Design	...	2
Graphics	4	...	Boiler Calculations	2	...
Thermodynamics	...	3	Boiler Design	...	2
Mechanical Laboratory	3	3	Applied Thermodynamics	2	...
Electrodynamics	2	2	Advanced Mechanical Laboratory...	6	3
Alternating Currents...	...	3	Marine Engines	1	1
Electrical Laboratory...	3	3	Naval Architecture	1	1
Calculus	4	...	Machine Design	3	3
Physical Measurements	4	4	Shop Visits	3	...
Analytic Mechanics	2	...	Specifications	...	1
Metallurgy	...	2	Thesis	...	9
			Advanced Electrodynamics... ...	3	...
			Electrical Measurements	2	...
			Electricity and Magnetism	...	3
			Electrical Testing	3	3
			Business Law	1	1

51. *Course in Electrical Engineering, Pennsylvania.*—The Freshman and Sophomore Classes are the same as for Mechanical Engineering. The Junior and Senior years are as follows :—

Subjects	Junior Year.		Subjects.	Senior Year.	
	Term 1.	Term 2.		Term 1.	Term 2.
Machine Sketching	3	3	Hydraulics	...	3
Statics	2	2	Engine Calculations...	2	...
Graphics	4	...	Boiler Calculations	2	...
Thermodynamics	...	3	Applied Thermodynamics	2	...
Mechanical Laboratory	3	3	Advanced Mechanical Laboratory...	3	3
Electrodynamics	2	2	Machine Design	3	3
Telegraphy and Telephony	2	2	Shop Visits	3	...
Alternating Currents...	...	2	Specifications	...	1
Electrical Laboratory...	3	3	Advanced Electrodynamics ...	3	...
Calculus	4	...	Electrical Measurements	2	...
Physical Measurements	4	4	Dynamo Design	...	2
Analytic Mechanics	2	...	Alternating Current Applications...	1	1
			Electricity and Magnetism	...	3
			Electrical Testing	6	3
			Thesis	...	9
			Business Law	1	1

52. *Courses in Civil Engineering, Penn.*—These are organised similarly to the courses in Mechanical Engineering—that is to say, there is a five-year and a four-year course.

PROGRAMME IN CIVIL ENGINEERING—PENNSYLVANIA UNIVERSITY.

Subjects.	Junior Year.		Subjects.	Senior Year.	
	Term 1.	Term 2.		Term 1.	Term 2.
Mechanics of Materials	4	...	Framed Structures...	...	5
Surveying Theory	3	...	Graphic Statics	...	1
„ Practice	3	3	Bridge Designing	...	2
(and two whole weeks.)			Masonry	...	3
Railroad Surveying, Theory	...	3	Railroad Economics	3	...
„ Practice... ...	...	3	„ Construction and Maintenance	3	...
(and two whole weeks.)					
Hydro-mechanics	...	4	Roads and Pavements	1	...
Pen Topography	...	2	Sanitary Engineering	...	2
English Composition and Literature	3	3	Stereotomy	2	...
German or French	2	2	Coloured Topography	2	...
Calculus	4	...	Map Drawing	2	...
Analytical Mechanics...	2	...	Economics	2	2
Physics...	3	3	Astronomy	3	...
			Practical Astronomy and Geodesy	...	4
			Physical Measurements	4	4
			Steam Engines and Boilers ...	2	2

Subjects.	Post-Senior Year.		Subjects—*continued.*	Post-Senior Year.	
	Term 1.	Term 2.		Term 1.	Term 2.
Materials of Construction	2	...	Thesis	...	6
Testing Laboratory	2	2	Applied Electricity...	2	2
Framed Structures	2	...	Mineralogy	2	2
Bridge Designing	4	4	Determinative Mineralogy ...	2	1
Geodesy Theory	...	1	Geology	2	...
Geodesy Practice	...	3	Metallurgy	...	2
Hydraulics, Works, Design	5	...	Business Law	...	2
Masonry Design	...	2	Inspection Tours	?	?

The four-year course is as follows —

Subjects.	Freshman Year.		Sophomore Year.	
	Term 1.	Term 2.	Term 1.	Term 2
Topography, Pen : Coloured	...	2	2	...
Lettering : Mechanical Drawing	2	...	2	...
Projections : Stereotomy	2	...	2	...
Geometry : Descriptive, Analytical	...	3	4	...
Trigonometry : Analytical Mechanics	4	...	...	2
Algebra : Calculus	...	4	...	4
Physics	2	2	3	3
Chemistry	4	4	4	4
English Composition : Literature	3	3	3	1
German or French	3	3	3	3
Surveying : Theory and Practice ... ... (And two whole weeks.)	...	...	6	3
Railroad Surveying : Theory and Practice ... ... (And two whole weeks.)	...	...	...	6

Subjects.	Junior Year.	
	Terms 1.	Terms 2.
Mechanics of Materials	4	...
Graphical Statics	...	1
Framed Structures	...	5
Bridge Designing	...	2
Masonry	...	3
Railroad Construction and Maintenance	3	...
Hydro-mechanics	...	4
Sanitary Engineering	...	2
Roads and Pavements	1	...
Map Drawing	2	...
Calculus	4	...
Physical Measurements	4	4
Analytic Mechanics	2	...
Mineralogy	2	2
Determinative Mineralogy ...	2	2
Business Law	1	1

Subjects.	Senior Year.	
	Terms 1.	Terms 2.
Materials of Construction ...	2	...
Testing Laboratory	2	2
Framed Structures	2	...
Bridge Designing	4	4
Railroad Economics	3	...
Geodesy Theory	...	1
,, Practice	...	3
Hydraulics Works Design ...	5	...
Masonry	...	2
Theses	...	6
Steam Engine and Boilers ...	2	2
Applied Electricity	2	2
Astronomy	3	...
Pract. Astronomy and Geodesy	...	4
Metallurgy	...	2
Geology	2	...
Business Law	1	1
Inspection Tours	?	?

53. *Courses in Chemistry.*—The chemistry of the first year consists in the execution of a rather extended series of experiments upon the metals and non-metals. The student omits only those of greater difficulty and such as require a skilled manipulator for their performance. In addition he attends lectures and recitations and solves numerous examples based upon the various reactions that he conducts practically. The skill and familiarity with chemical methods acquired in this way will fully prepare him for the work of the second year, which is mainly analytical, though considerable time is allotted to the preparation of a selected series of inorganic salts.

In quantitative analysis he is given every opportunity to familiarise himself with purely scientific methods, in gravimetric, electrolytic, and volumetric analysis; also with gas analysis, the use of the spectroscope, and the methods of technical analysis applied in the various branches of chemistry. The instruction in theoretical chemistry is imparted by lectures; that in applied chemistry by lectures, supplemented by frequent visits to chemical plants in this and adjacent cities. The lectures and recitation in organic chemistry are conducted parallel with practical work on this subject. The aim is to have the student prepare typical substances from the whole field of organic chemistry. The most recent methods of analysis peculiar to this field receive due attention. In the last year the student pursues advanced work in the direction of pure inorganic, organic, or technical chemistry. The solution of some problem in one of these branches will constitute the thesis that must be prepared for the final examination.

Programme of the Longer Course in Chemistry—University of Pennsylvania.

Subject.	Junior.		Subject.	Senior.		Subject.	Post-Senior.	
	Term 1.	Term 2.		Term 1.	Term 2.		Term 1.	Term 2.
Quantitative Analysis ...	12	12	Practical Organic Chemistry	6	6	Practical Organic Chemistry	10	10
Assaying	4	4	Organic Chemistry ...	2	2	Analysis of Foods ...	6	6
Mineralogy	2	2	Applied Chemistry ...	2	2	Theoretical Chemistry	1	1
English.	3	3	Mineralogy (descr.) ...	2	2	Electro-chemistry ...	...	1
German or French ...	2	2	Mineralogy (determ.)	2	2	Geology	2	2
Physics	3	3	Economics	2	2	Business Law ...	1	1
			Phys. Measurements	4	4			
			Metallurgy	1	1			

The

The four-year course is organised as follows :—

Subjects.	Freshman Year. Term 1.	Freshman Year. Term 2.	Subjects.	Sophomore Year. Term 1.	Sophomore Year. Term 2.
General Chemistry	8	8	Qualitative Analysis	18	18
Algebra	...	4	English	3	3
Solid Geometry	2	...	German or French[1]	5	5
German or French	3	3	Mineralogy	2	2
English	3	3	Physics	3	3
Freehand Drawing	2	2	Optional Mathematics, or Botany, or Physics.	?	?
Elementary Practical Physics	4	4			

Subjects.	Junior Year. Term 1.	Junior Year. Term 2.	Subjects.	Senior Year. Term 1.	Senior Year. Term 2.
Qualitative Analysis	13	13	Organic Chemistry	2	2
Applied Chemistry	2	2	Practical Organic Chemistry	12	12
Assaying	4	4	Analyses of Foods	10	...
Ethics	...	...	Theoretical Chemistry	1	1
German or French	2	2	Electro-chemistry...	...	10
English	2	2	Economics	2	2
Mineralogy	4	3	Geology	2	2
Metallurgy	1	1	Business Law	1	1
Optional Physics, Micr. Botany... ...	?	?			

54. *Equipment for Technology, Pennsylvania University.*—The extensive equipments of the technological side of the University were inspected by the Commissioners. Among special features noted may be mentioned electric furnaces and equipment for electro-chemistry.

The library of the University possesses over 250,000 volumes.

For astronomical practice there is an observatory (the Flower Astronomical Observatory) with an 18-inch equatorial with spectroscope, a meridian circle, zenith telescope (each 4-inch), a 3-inch universal transit.

55. *Other Universities.*—What has been indicated of the provision made for higher technical instruction in the United States, is probably sufficient to disclose the American view of the importance of technology. The work done in other Universities may now be briefly referred to.

In the University of *Michigan* there are courses in civil, mechanical, electrical, chemical, and marine engineering and naval architecture, the work extending in each case through four years. A special feature of the equipment noticed by the Commissioner during his visit was an extensive tank-building for experiment, on a large scale, of the resistance to the motion of models and vessels. This structure is not only the largest in America, but also in the world, for that purpose.

The *Princeton University*, of which the John C. Green School of Science is an integral part, has a course in Civil Engineering, in Electrical Engineering, and in General Science.

The *University of Wisconsin* has courses in Civil Engineering, Sanitary Engineering, Mechanical Engineering, Electrical Engineering, Applied Electro-chemistry, General Engineering, Mining and preliminary training for Mining and Metallurgical Engineering. Its agricultural courses are referred to in another chapter. Examples could be multiplied but would serve no useful purpose.

[1] Literary and scientific.

CHAPTER XXXIX

CHAPTER XXXIX.

Technical Education in The United Kingdom.

[G. H. KNIBBS.]

1. *Introduction.*—At the head of institutions providing technical education in the United Kingdom, stand the Universities, the more modern of which have made considerable provision for technical instruction. Even the older Universities are responding to modern demands, and are making changes, the practical character of which discloses how far-reaching is the compulsion of recent reform ideas in the organisation and curriculum of the University, and to how great an extent the original conception of its proper function has undergone modification.

Next in academic dignity to the University stands such an institution for example as the "Royal College of Science," of South Kensington, and the Polytechnics and Higher Colleges. The "Technical Institutes" and "Arts and Crafts" Schools, and schools for instruction in special industries and trades, constitute the lower plane of effort in technical education, though beneath these again may be ranked the manual training schools, and lastly, the kindergartens.

The object of this chapter is to give a brief sketch of the character, and some of the details, of the provision which is now made in the United Kingdom for various forms of technical and industrial education.

2. *Kindergarten and Manual Training.*—The value of the kindergarten, and of the manual training in the elementary school, viz., either Sloyd or some form of exercises in carpentry, or wood or metal work, is becoming better recognised in the United Kingdom. At the present time there is, however, no adequate attempt to thoroughly organise this type of instruction. All that can be said is that *educationists* fully recognise its value, and a large number of schools are being equipped in material and personnel for such teaching.

The kindergarten is admitted to be an excellent preparation for the severer and more advanced exercises which are to be found in Sloyd, or in other forms of manual training.

3. *Technical Education under the Board of the London County Council.*—The work done under the supervision of the Technical Education Board of the London County Council may now be referred to as being the most comprehensive attempt throughout the British Empire, to deal with the need for technical education. This will be evident from the following list of Institutions under its care :—

INSTITUTIONS AIDED OR CONDUCTED BY THE LONDON COUNTY COUNCIL.

[1.] *The University and Schools of the University* (5).—University of London ; Bedford College, London ; King's College, London ; London School of Economics and Political Science ; University College, London.

[2.] *Polytechnics* (8).—Battersea Polytechnic Institute ; Borough Polytechnic Institute ; City Polytechnic, comprising : Birkbeck College, City of London College, and Northampton Institute ; Northern Polytechnic Institute ; Regent-street Polytechnic Institute ; South-Western Polytechnic Institute ; Woolwich Polytechnic Institute (here it may be remarked that the East London Technical College—People's Palace—and the Goldsmiths' Institute, New Cross, are not aided by the Council).

[3.] *Institutions conducted by the Council* (14).—Camberwell School of Arts and Crafts ; L.C.C.[1] Camden School of Arts ; L.C.C. Central School of Arts and Crafts ; L.C.C. Clapham School of Art ; L.C.C. Hammersmith School of Art ; L.C.C. Paddington Technical Institute ; L.C.C. Poplar Technical Institute ; L.C.C. School of Building ; L.C.C. School of Carriage Building ; L.C.C. School of Photo-Engraving and Lithography ; L.C.C. Shoreditch Technical Institute ; L.C.C. Sydenham Technical Institute ; L.C.C. Westminster Technical Institute ; London Day Training College.

[4.] *Technical Institutes conducted by separate governing bodies* (12).—Aldenham Institute, St. Pancras ; Church Institute, Upper Tooting ; Craft School, Mile-end ; Devas Institute, Battersea ; Hackney Institute (Cassland House) ; Hackney Institute (Central Branch) ; Herold's Institute (Branch of Borough Polytechnic Institute) ; Norwood Technical Institute (Branch of Borough Polytechnic Institute) ; Royal School of Art Needlework ; St. Bride Foundation Institute ; School of Art Woodcarving, South Kensington ; Wandsworth Technical Institute.

[5.] *Schools of Art aided by the Council* (6).—Blackheath, Lee and Lewisham School of Art ; Clapton and Stamford Hill School of Art ; Lambeth School of Art ; Putney School of Art ; Royal Female School of Art ; St. Martin's School of Art.

In considering the provision for art education in London it should be borne in mind that every polytechnic, except the Northern Polytechnic, possesses an *Art Department* which is said to be entitled to rank as a *School of Art,* and in some cases as a *School of Arts and Crafts.*

[6.] *Certain Evening Classes in Science, Art and Technology, which do not of themselves constitute organised Institutions* (4).—The evening science and art classes at Bell-lane, E. (the Jews' Free School) ; the science and art classes at the Morley Memorial College ; the evening science classes at the William Ellis Endowed School ; the science and art classes at the Working Men's College.

The Council also aids a *School of Practical Gardening* conducted by the Royal Botanic Society.

[7.]

[1] L.C.C. denotes London County Council.

[7.] *Secondary Schools* (49).—(*a*) *Boys' schools* (25), viz.—Alleyn's School, Dulwich; Aske's School, Hampstead; Aske's School, Hatcham; Battersea Grammar School; Borough Polytechnic Institute Day School; Central Foundation School, Cowper-street; Cooper's Company's School, Bow; Emanuel School, Wandsworth-common; Latymer Upper School, Hammersmith; L.C.C. Shoreditch Technical Institute; Owen's School, Islington; Parmiter's School, Victoria-park; Raine's Foundation School, St. George's-in-the-East; Regent-street Polytechnic Institute Day School; Roan School, Greenwich; St. Dunstan's College, Catford; St. Mark's College Upper School, Chelsea; St. Olave's and St. Saviour's Grammar School, Southwark; Sir Walter St. John's School, Battersea; Tenison's School, Leicester-square; University College Day School, Commercial Department; Westminster City School; Whitechapel Foundation School; William Ellis Endowed School, Gospel-oak; Wilson's Grammar School, Camberwell. (*b*) *Girls' schools* (16).—Aske's School, Hatcham; Burlington School, St. James's; Camden School, Prince of Wales-road; Central Foundation School, Spital-square; Coborn School, Bow; Greycoat School, Westminister; Highbury Hill House School; James Allen's School, Dulwich; Owen's School, Islington; Regent-street Polytechnic Institute Day School; Roan School, Greenwich; St. Aloysius' Convent School, Clarendon-square; St. Martin's High School, Charing Cross road; St. Mary's College, Paddington; St. Saviour's and St. Olave's Grammar School, Southwark. (*c*) *Mixed schools, or separate departments* (8).—Addey and Stanhope School, Deptford; Battersea Polytechnic Institute Day School; George Green's School, Poplar; Northern Polytechnic Institute Day School, Holloway; Queen's-park, College; South-western Polytechnic Institute Day School, Chelsea; Wandsworth Technical Institute; Woolwich Polytechnic Institute Day School.

[8.] *Domestic Economy Schools and Classes* (22).—The domestic economy training school at the Battersea Polytechnic Institute; the National Training School of Cookery (for scholars' fees only). The domestic economy schools at Albany Institute, Deptford; Battersea Polytechnic Institute; Borough Polytechnic Institute; Church Institute,[1] Upper Tooting; Craft School, Mile End; L.C.C. Paddington Technical Institute; L.C.C. Shoreditch Technical Institute; Northampton Institute; Northern Polytechnic Institute; Norwood Technical Institute[2]; Passmore Edwards Settlement; St. Mark School of Domestic Economy, St. John's Wood; Sir. John Cass's Technical Institute; South-western Polytechnic Institute; Wandsworth Technical Institute; Woolwich Polytechnic Institute.

The Sailors' School of Cookery for the training of ships' cooks. (This school, which is conducted by the Council at the Sailors' Home, Dock-street, should be included as a domestic economy school, though differing essentially from the schools named above.)

Domestic economy classes are held at:—College for Working Women; Morley Memorial College; and Regent-street Polytechnic Institute.

The preceding list discloses the extent and nature of the scheme of providing for technical education in and near the metropolis of Great Britain. The Commissioners saw the whole range of work represented in these institutions.

4. *Progressive Expenditure on Technical Education.*—The cash expenditure of the London County Council on the several branches of its work for each financial year since its establishment is instructive, as shewing the response which is being made in England to the call for improved technical education. The results are given to the nearest pound sterling.

Table shewing Progressive Increase in Expenditure for Technical Education under the London County Council.

Services.	Years and Expenditure.										
	1893–4.	1894–5.	1895–6.	1896–7.	1897–8.	1898–9.	1899–0.	1900–1.	1901–2.	1902–3.	1903–4.
Technical Departments of Polytechnics	1,000	11,494	23,230	26,678	27,314	30,202	31,247	42,248	37,405	38,230	56,880
Technical Departments of Higher Educational Institutions.	...	1,500	2,000	2,000	5,000	3,500	3,900	4,600	3,800	12,573	17,987
Technical Schools.....	131	877	1,600	2,784	10,560	11,348	21,496	31,887	21,822	48,047	71,752
Technical Departments of Public Secondary Day Schools.[3]	...	9,106	14,049	35,573	20,236	24,565	5,038	43,795	26,627	31,411	39,848
Country Scholarships	733	5,805	14,450	21,406	26,160	28,288	29,038	27,053	30,588	33,980	33,129
Art Teaching, Science and Technology, Manual instruction.	727	7,108	13,307	16,656	13,835	15,596	13,276	16,945	13,988	19,149	25,092
Domestic Economy	402	2,549	2,258	3,739	6,011	5,984	5,495	7,048	7,039	6,903	1,783
Commercial Education	...	...	250	1,150	1,200	1,248	604	2,203	2,711	9,917	9,538
Technical Museums	...	...	...	......	475	686	293	171	249	194	221
Expenses of Administration	1,447	3,560	5,115	5,547	6,953	7,583	7,504	7,803	8,404	9,337	9,538
Government grants	...	...	...	......	......	......	27,416	23,992	20,472	25,987	36,686
King's Scholars	...	...	...	......	......	......	......	......	......	776	2,731
Board of Education examinations	...	...	...	......	......	......	......	......	......	......	1,916
Totals[4]	4,529	41,999	76,560	115,533	117,744	128,999	145,358	207,747	173,104	236,505	305,213

The response, if not adequate, at least unmistakeably testifies to the recognition of the need for technical education.

The

[1] Forms part of organisation of Battersea Polytechnic Institute for Domestic Economy classes.
[2] Branch of Borough Polytechnic Institute.
[3] Including school fees.
[4] Totals may not add up correctly, because of casting to nearest £1.

The development of evening instruction in the polytechnics, aided by the Council, also shews the way in which the opportunity is grasped by the youth of the nation. Neglecting to take account of all cases where the total attendance in any subject is less than twenty hours, the following table, in which the unit is 100 *student hours*, exhibits the total attendance for representative subjects.

Table shewing total evening attendance in representative subjects.

Subjects.	Year[1] and Student Hours (in hundreds).							
	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
Mechanical Engineering	171	292	217	493	669	848	895	925
Electrical Engineering	41	60	81	139	165	182	247	314
Carpentry and Joinery	14	72	83	107	232	197	201	231
Plumbing	68	155	171	179	225	213	202	196
Building Trades[2]	375	486	517	676	887	979	999	1,234
Experimental Physics	167	164	225	200	369	634	640	758
Chemistry (Inorganic and Organic)...	237	315	386	444	514	609	561	521
Mathematics	114	138	154	206	189	281	282	366
Totals[3]...	1,187	1,582	1,835	2,442	3,151	3,943	4,026	4,544

In 1892 "there was scarcely any provision in London for technological teaching," according to the Annual Report of 1903–4. From the *London Technical Education Gazette* for 1903, it appears that the extent of the provision by way of evening classes for the more important subjects is as follows:—

Number of Institutes providing evening instruction in important subjects.

Subject.	No. of Institutions.	Subject.	No. of Institutions.
Brick-making and Brick-cutting	12	Photo-process work...	4
Cabinetmaking	9	Plastering	9
Carpentry and Joinery	20	Plumbing	15
Furniture Design	9	Printing	4
Masonry	9	Smithing	6
Metal-plate work	8	Tailors' Cutting	7
Painting and Decorating	12	Upholstery	6

[1] Year ending in 1894, *i.e.*, 1893-4.

[2] Includes brickwork and masonry.

[3] May not correspond exactly to addition, because of casting to nearest 100. Throughout add 00 for the actual number.

5. *Variety of Technical Education under London County Council.*—The progress during the last ten years, as regards the variety of subjects taught, has been very great. In the following table for the years 1894 and 1904 the figures denote the number of *centres* where instruction is given. Only in tanning and carriage-building have there been a reduction in the number of centres.

Table shewing number of centres where certain subjects were taught in 1894 *and* 1904.

Subject.	1894.	1904.	Subject.	1894.	1904.
Baking	1	1	Leather-dyeing	...	1
Book-binding	2	3	Lithography	...	4
Boot and Shoe manufacture	3	3	Masonry	1	9
Brass-finishing	1	3	*Mechanical engineering*	8	24
Brick-work and brick-cutting ...	9	12	Metal-plate work	7	8
Cabinetmaking	5	9	Milling	...	1
Candle making	...	1	Optical instrument making... ...	...	1
Carpentry and joinery	16	20	Opticians' work	...	2
Carriage building	3	2	Painters' and decorators' work ...	9	12
Carving and gilding (picture-framers)	...	3	Paper manufacture	...	1
Chair-making	...	1	Photo.-process work...	...	5
Chasing and embossing	...	4	Plasterers' work	3	9
Collotype	...	3	Plumbing	9	15
Colour making	...	3	Press-tool making	...	1
Cycle and motor making	...	3	Silversmith's work	...	7
Diamond mounting	...	1	Smithing	...	6
Electrical engineering	5	16	Soap manufacture	...	1
Electrical Instrument making ...	...	3	Stained glass work	...	3
Electric wiring and fitting	3	7	Staircasing and handrailing... ...	3	6
Electro-metallurgy	...	1	Stone-carving	...	5
Electro-plating	...	2	Tailors's cutting	4	7
Electrotyping and stereotyping ...	...	1	Tanning	2	1
Enamelling	...	6	Typography and letter-press printing	2	4
Engraving	...	3	Upholstery	1	6
French polishing	...	3	Varnish making	...	3
Furniture design	...	9	Watch and clock making	...	2
Furniture enamelling...	...	1	Wheelwrights' work...	1	2
Furriers work	...	1	Wood carving	13	27
Goldsmith's work	...	3	Woodcuts in colour	...	1
Hairdressing	...	1	Wood engraving	1	2
Instrument making	...	4	Zinc work	1	1
Iron and steel manufacture	...	1			
Jeweller's work	...	2	Totals	113	313

The significance of the development in mechanical and electrical engineering calls for special remark.

The rapid growth which is here indicated has by no means come to a stand still. The number of workmen, for example, attending the artisan classes has increased 38 per cent. in the interval, 1901–1903.

The variety of type of school is suggested by the names in the following list of schools for technical instruction in or about London.

(i) Polytechnic Institutes (*a*—Battersea; *b*—Borough; *c*—City, including Birbeck College, City of London College, Northampton Institute, Northern, Regent-street, South-western, Woolwich).

(ii) Technical Colleges or Institutes (East London; Sir John Cass'; Paddington; Poplar; Shoreditch; Sydenham; Westminster; Wandsworth).

(iii) Institutes (Goldsmiths'; Hackney; Herold's[1]; St. Bride Foundation[2]).

(iv) Arts and Crafts Schools (Central School, Regent-street; Camberwell).

(v) Various (School of Building, Brixton; School of Photo-engraving and Lithography; Leather Trades School, Bethnal Green Road; Trades Training School).

Identity or difference in name, however, by no means implies absolute identity or dissimilarity of function. Again a Polytechnic in Great Britain is not of the same academic rank as the Polytechnic of Europe, or the *Technische Hochschule* of Austria or Germany.

Each Polytechnic has special activities, for example the Battersea Polytechnic includes the principal training school for domestic economy teachers; it is the only Polytechnic specialising in paper manufacture, or providing classes for *chauffeurs*; it is specialising also in electric traction, and in the chemistry of oils and colours.

In the Borough Polytechnic there is a National School for Bakers and Confectioners; it possesses the only school in London for Varnish Manufacturers.

The Polytechnic in Regent-street has a special type of School of Photography; it possesses also a unique School of Carriage Building.

A large part of the work done is for the further training and development of the artisan already fully occupied in the day. For example, the Northampton Institute, St. John's Road, Clerkenwell, is a Technical School for the skilled artisan. Regarded

[1] For leather dyeing and tanning. [2] Typography, lithographic printing, etc.

Regarded as a whole, the work of the Technical Schools, as at present constituted, shew by their organisation that they are intended to make good in the quickest manner possible the more serious of the defects in the technical education of the people, and their general development and whole organisation will necessarily be modified as Great Britain attains to more thoroughness of method in her educational system.

For a more detailed view, it will be necessary to turn to programmes of individual schools.

6. *Technological and Professional forms of Education in the Universities.*—Courses—Civil mechanical, and electrical engineering, in agriculture, brewing, and in commerce, are to be found in the Universities; and even the older Universities are being forced to recognise that they must adapt themselves to the real needs of the people—needs that are determined largely by the circumstances of modern civilisation.

In the sections immediately following, some brief reference will be made to various forms of technical education, which are to be found in the Universities.

The University of Birmingham is one of the most recent, and its organisation was decided upon after some study of the failure of Universities of the type of Oxford and Cambridge to meet important national requirements.

It has courses in various branches of engineering, in metallurgy, mining, brewing, education, commerce, etc.

7. *Engineering Courses, University of Birmingham.*—The University of Birmingham makes provision for higher technical education by offering courses in civil, mechanical, and electrical engineering. Each of these is of four years' duration, leading to the degree of Bachelor of Science (B.Sc.) in the branch of Engineering studied. The Master of Science (M.Sc.) degree may be obtained a year later, or the Doctor of Science (D.Sc.), after a period of two years from passing the B.Sc. In the three courses the first two years are identical; the specialisation is in the third and fourth. There are Machine Drawing Courses, Workshop Courses, and a Brewing Course. Students may enter upon these courses after Matriculation, or on the production of evidence that they have passed one of the Examinations which the University accepts as exempting from the Matriculation Examination.

The instruction given in the first two years of the civil, mechanical, and electrical engineering courses, is of the following description:—

(i.) *Descriptive Engineering,* which includes the description of tools and machinery used in Engineering, such as hand tools for wood and iron, types of boilers and boiler fittings, steam engine parts, types of steam-engines, gas and oil engines.

(ii.) *Graphics and Geometry,* including graphical mensuration, vectors and mass centres; graphical statics; and the kinematics of machinery.

(iii.) *General Engineering,* the subjects treated being strength of materials (elementary course); hydraulics; elementary theory of the heat engine; machine design: its general principles, and such details as fastenings, screws, keys, and cotters, riveted joints, boilers, pipes and pipe-joints and shafting and couplings.

Besides these, chemistry, physics and mathematics, and surveying are taken.

The *Third Year Course* for Civil Engineering students consists of lectures in (*a*) general engineering; (*b*) civil engineering—which includes surveying, simple constructional work and hydraulics; (*c*) electrical engineering, dealing with magnetic fields, electric currents, electrical resistance, direct reading instruments, secondary cells, laws of electro-magnetic induction, the magnetic circuit, dynamos and motors, and central stations; (*d*) general and electrical laboratory practice and drawing and workshop practice; and (*e*) geology, which includes lectures, laboratory practice, and surveying.

The *Third Year Course for Mechanical Engineering Students* is similar to the above, except that mechanical engineering, including general theory of friction, applications to rolling friction, chains, bolts, transmission of power by ropes and belts, by gearing, link-work, valve gears, Zeuner diagrams, trip gears, expansion gears, governors, flywheels, balancing of engines, is taken instead of civil engineering, and courses in physics and metallurgy are included, while geology is omitted.

The *Third Year Course for Electrical Engineering Students* is the same as the one immediately preceding, except that metallurgy is omitted.

The Fourth Year Course for Civil Engineering Students consists of lectures in civil engineering, concerning masonry construction, iron and steel construction, and "water engineering." There is also laboratory practice and drawing; and in geology lectures and laboratory practice are included.

The Fourth Year Course for Mechanical Engineers includes lectures on mechanical and electrical engineering, the former dealing with the advanced theory of the strength of materials, of the heat engine and the transmission of power by air, electricity, water, gas, cost of power, and load factor; the latter with the design of various forms of continuous current machinery, etc., alternating currents, central stations for lighting and power distribution, etc. There is also practice in the mechanical and electrical laboratories, and drawing and workshop practice.

The Fourth Year Course for Electrical Engineering Students is identical with the preceding one. The laboratory practice is differently organised, however.

The *Machine Drawing Courses* are of four years' duration; so also are the *Workshop Courses,* wherein the students receive practice in woodwork, lathe work, pattern making, metal work, vice, lathe, milling and fitting.

The *Brewing Course in Engineering* deals with machinery for hoisting and lifting (*e.g.,* pulley-blocks, hydraulic jacks, windlasses, conveyers, etc.), with boilers, steam-engines, oil and gas engines, filtration, etc.

8. *British School of Malting and Brewing, Birmingham University.*—The School of Malting and Brewing was founded to encourage research in all branches of knowledge connected with the fermentation industries. "The necessity," says the *Calendar,* "of scientific training as a requisite to modern advance in technology is day by day becoming better recognised by the manufacturers of this country."

The

The course is three years, and is as follows:—

1*st Year.*—Elementary inorganic chemistry; physics; botany; mathematics; engineering drawing; modern languages (optional). The course may be varied to suit students' previous education.

2*nd Year.*—Advanced chemistry, inorganic and organic, with extended course of laboratory work; practical elementary bacteriology; engineering and electrical engineering; short course on geology.

3*rd Year.*—Work in the brewing laboratory; distilling; vinegar-making; brewing.

Besides lectures and laboratory work, excursions are made to breweries and malting establishments, etc.

9. *Technical Courses at Liverpool University.*—Liverpool University confers the following degrees in the Faculty of Engineering, viz., the Bachelor (B. Eng.), Master (M. Eng.), and Doctor (D. Eng.). The *Bachelor* degree (from 1st October, 1905) is conferred after three sessions' (years) study following on *after* matriculation, and passing the necessary examinations.

The degree of *Master* is conferred on Bachelors of not less than three years' standing, who satisfy the Faculty that they have pursued the science or practice of engineering during three years subsequent to graduation. Those who have taken only the ordinary pass must pass a further examination, or present an approved dissertation; but those who have passed with honours are exempt from this condition.

10. *The City of Liverpool School of Architecture and Applied Art.*—This school is domiciled in the University of Liverpool. Seven courses are given in architecture, two in each of the following, viz.:—Sculpture and modelling; decorative design; drawing and painting. These cover the following range:—

	Lectures.
Architecture Courses—	
(*a*) Greek, Roman, Saxon, English Gothic Architecture	1 per week.
(*b*) Christian, Byzantine, Romanesque, Gothic, and Renaissance Architecture ...	1 "
(*c*) Building materials and construction...	1 "
(*d*) " " "	1 "
(*e*) Perspective and sciography	1 "
(*f*) Advanced design (evening course) Autumn and Lent terms	1 per 14 days.
(*g*) Elementary design " " "	1 "
Sculpture and Modelling—	
(*a*) Life modelling...	2 days.
(*b*) Antique modelling or ornament	3 "
Decorative Design—	
(*a*) Elementary	3 afternoons.
(*b*) Advanced	3 "
Drawing and Painting—	
(*a*) Life	3 days.
(*b*) Antique	3 "

As is obvious these are not courses leading to a degree.

11. *Technology in the Victoria University, Manchester.*—The Owens College, opened in 1851, in pursuance of a bequest of John Owens of Manchester of £96,654, was incorporated under Acts of Parliament in 1870 and 1871. About £100,000 was raised in 1870–3, and in 1873 a new college was opened, thus increasing the accommodation. The jubilee of the college was celebrated in 1902 by raising £102,500 for further extension. A charter as a University was applied for in 1819, and the *Victoria University* was founded by Royal Charter on 20th April, 1880, Owens College being constituted a college of the university. The Yorkshire College, Leeds, is also a college of the university (3 October, 1887). From 1 October, 1906, the degree courses will not be less than three years *after* matriculation. Matriculants must pass in either Greek, or Latin, or French, or German, or other approved modern language; that is to say, neither Latin nor Greek is compulsory.

Engineering is included under the Faculty of Science, and there is a considerable range of option in the course. The degrees conferred are Bachelor, Master, and Doctor of Science.

Agriculture may also be taken in the science course.

Besides the ordinary course there are what are called Honours Schools, viz.:—The Honours School of Architecture, of Mathematics, of Engineering, of Chemistry, etc., etc.

Besides the degrees, certificates of proficiency in special subjects are given, for example:—

(i) Engineering; (ii) Electrical Engineering; (iii) Applied Chemistry; (iv) Agriculture; (v) Coal-mining; (vi) Certificates for women. There are twenty subjects in this last for any one of which a certificate may be obtained.

The certificates are granted on the successful completion of the courses.

Besides the regular courses there are *Evening, Special, Saturday, and Popular Courses.* Among other subjects are included civil engineering, mechanical engineering, engineering laboratory practice, electro-chemistry, chemistry, mining, botany, etc. Public lectures have been given on architecture, field lessons or nature study, and Saturday and Sunday lectures on matters of technical or general interest.

12. *Technical Instruction, Yorkshire College, Leeds.*—The Yorkshire College of Leeds is a college of the Victoria University. The provision it makes for technical instruction is considerable. Encouragement is given by scholarships, exhibitions, bursaries, and class prizes. Its laboratories are well equipped.

The courses are mainly of three years' duration, and either lead to the B.Sc. Degree after passing the three examinations, viz., the preliminary, the intermediate, and the final, set by the *Victoria University, i.e.,* the University with which this College is associated; or to "Certificates of Proficiency," or "Diplomas." The degrees apply, of course, only to the courses in Engineering Science, and Agriculture, and the Diplomas to Agriculture only. In the case of Agriculture, if the preliminary examination has not been passed before entering the College, a four-year course is necessary.

The

The technical courses of study leading to the B.Sc. degree are:—

(i) Physics (including experimental lectures, laboratory work, electricity and magnetism, mechanics heat, acoustics, light, etc.)

(ii) Chemistry (inorganic, organic, laboratory practice, etc.)

(iii) Geology (palæontology, applied geology, petrology, mineralogy, agricultural geology, geology applied to sanitary and civil engineering, field course, laboratory, geology applied to coal-mining).

(iv) Civil and Mechanical Engineering, which includes (*a*) Lectures on engineering principles and work; (*b*) Instruction in machine and geometrical drawing; and (*c*) Experimental work in the engineering laboratory. There is also a two-year course in this subject and a two-year course specially suitable for architectural students.

(v) Electrical Engineering, comprising (*a*) Lectures; (*b*) Exercises; (*c*) Electrical design and drawing; (*d*) Practical work in the laboratories.

(vi) Agriculture, the subjects of which are chemistry and physics, natural history, chemical laboratory work, practical agriculture, agricultural chemistry, agricultural botany, book-keeping, mathematics, veterinary science, economic entomology, geology, agricultural engineering, surveying, forestry, poultry-keeping, farm bacteriology, and field surveying and levelling.

Entrance to the Engineering Department is obtained by passing an examination in arithmetic, geometry, and algebra up to simultaneous equations, or on production of certificates of having passed the Oxford and Cambridge local examinations in mathematics, London matriculation, Victoria preliminary, or other approved examination.

The courses of study leading to the Certificates of Proficiency are the following, viz.:—

(*a*) *Engineering Sciences* mentioned above, the programme of study, however, being different, and the passing of the preliminary examination is not required. The studies of the first year are practically the same for Civil, Mechanical, and Electrical Engineers.

(*b*) *The Textile Industries*, embracing a course of two years, viz., textile designing and cloth finishing; and two courses of three years each, viz., (1) Spinning, textile designing, and cloth finishing; and (2) Spinning, textile designing, cloth finishing, and dyeing.

In addition lectures must be taken in spinning, applied art, French or German, and drawing practice, for the first course; for the second, in engineering, applied art, French or German, and practice in machine drawing; and for the third, lectures in inorganic chemistry and dyeing. The artistic side of the textile industries is comprehensively dealt with.

(*c*) *Dyeing*, instruction in which is given by means of lectures on textile fibres, bleaching and scouring, mordants, natural and artificial colouring matters; and by work in the experimental and practical dye-houses; and also in the printing department.

If students can remain longer than the prescribed term of three years, the remaining time is spent in the dyeing department, including the research laboratory.

(*d*) *The Leather Industries and Chemistry.*—The subjects of study required for the first year are chemistry, chemical laboratory, general engineering, mechanical drawing, German or French, also physics (short course), if possible; for the second year, the subjects are general principles of tanning, organic chemistry, German or French, chemical laboratory (organic), and leather industries laboratories; the third-year course embraces lectures on mineral and special tannages; on chemistry of leather manufacture; on currying, dyeing, and leather finishing, and on technical microscopy and bacteriology.

There is also a two-year course qualifying for the Yorkshire College certificate in leather manufacture. To become a member of the International Association of Leather Trades Chemists, it is necessary first of all to take the B.Sc. Degree course in Chemistry, and at least a final year in the Leather Industries Department.

The Course in Mining is the only course which leads neither to Degree nor Certificate of Competency. It has three distinct courses of study, which are as follows, viz.:—(1) A three years' course in General Mining; (2) A three years' course in Coal Mining, and (3) a two years' course in Coal Mining. The first course is intended for students who desire to qualify themselves as Mining Engineers, Surveyors, or Assayers, and particularly for those who intend, in the future, to take charge of mining and prospecting operations in the colonies or foreign countries. The second course is intended principally for those who wish to obtain a Colliery Managers' Certificate, and the third is for those who desire to qualify themselves for Manager's Certificates under the C.M.R. Act.

In addition to the above, there are also evening courses given in physics, civil and mechanical engineering, electrical engineering, sanitary engineering, textile industries, dyeing, and the leather industries. These, however, lead neither to certificate nor degree, and are simply special courses in such subjects.

13. *The Durham College of Science, Newcastle-upon-Tyne.*—The Durham College of Science was founded on the 24th October, 1871, jointly by the University of Durham and the North of England Institute of Mining and Mechanical Engineers. It forms an important part of the University of the North of England, and has the recognition and approval of the Board of Agriculture, as offering a training in every branch of this pursuit. There are both day and evening classes. Students are divided into Matriculated and Non-matriculated. The Matriculated Students are required to pass an entrance-examination in arithmetic, English essay, Euclid, Book I, algebra, including simple equations, and in *two* of the following subjects:—English, Latin, Greek, French, German, geography. The passing, however, of one of the following examinations exempts them from Matriculation, viz.:—The Certificate of Proficiency Examination; the Preliminary Examination in Arts; Durham, Oxford, or Cambridge Senior Local or Schools Examinations, or the Junior Local in the first class; the Matriculation Examination of any University in the British Empire; the King's Scholarship Examination; Examinations for Senior County Scholarships; the Examination of the College of Preceptors, in the First Class. They may become candidates for the Title of *Associate of Science* (A.Sc.), after a two years' course of study; for the *Degree of B.Sc.* after a three years' course, preceded by the passing of the preliminary examination in Arts for graduation in Science, or one of its equivalents, or the First B.Litt. Examination; for the *Degree of M.Sc.*, after holding the Degree of Bachelor of Science for two years; or for the *Degree of D.Sc.* after being a Master of Science for not less than seven years. The Non-Matriculated students are not required to pass an entrance-examination; they may select any studies they desire, and are eligible for the College Certificates.

Candidates

Candidates for the Title of A.Sc., in their first year, take the elementary parts of mathematics experimental physics, chemistry, and either geology or natural history. In their second year, they take in their advanced stages any two of these subjects, but should they offer a third subject, they are required to pass in all three. This does not apply to Agricultural Students. These present themselves for examination in chemistry, especially agricultural chemistry, and Agriculture, including the tillage, amelioration, and manuring of soil, the cultivation of farm crops, the management of pastures and meadows, anatomy and physiology of farm animals, agricultural botany, agricultural geology, agricultural entomology, and land surveying. After the lapse of one year from the obtaining of the title, Associates in Science may sit for the examination for the degree of Bachelor of Science.

The B.Sc. degree is given in Pure Science, in Agriculture, and in Engineering Science. To obtain the first it is necessary to be an Associate in Science, which means a course of study lasting two years, to have passed the Preliminary Examination in Arts for Graduation in Science or an equivalent, and at the end of the third year to have passed an examination in four of the following subjects:—Mathematics, experimental physics, inorganic and organic chemistry, geology, palæontology and petrology, mineralogy, crystallography, botany, zoology, physiology, *agriculture*, including: the principles of breeding and the general management of live stock, dairying, the stocking of farms, pathology, and farm hygiene, forestry, estate management, agricultural engineering, book-keeping, organic chemistry, and chemistry applied to agriculture and advanced botany.

The degree of B.Sc. in Engineering Science may be obtained in any one of the following departments, viz.:—General Mechanical Engineering[1], (2) Naval Architecture[1], (3) Civil Engineering, (4) Electrical Engineering, (5) Mining, and (6) Metallurgy. The possession of the title of Associate in Science is not a necessary condition for the obtaining of the B. Sc. degree in these subjects, but candidates must, before entering on their course of study, have passed the Preliminary Examination in Arts for Graduation in Science. The courses of study are all of three years' duration, and for the first year, the studies are alike for all, viz.:—Mathematics, physics and practical physics, chemistry and practical chemistry, and practical, plane and solid geometry.

For *General Mechanical Engineering* the course of study for the second year comprises: Applied Mechanics (junior engineering), engineering (laboratory), and mechanical drawing, and *one* of the following:—Mathematics, physics or chemistry, as required of students in science in their second year. For the third year the subjects studied are:—Engineering (senior and advanced classes and laboratory) and mechanical drawing, also one of the following:—Mathematics, physics or chemistry, as required of students in science in their third year. The requirements for *Naval Architecture* and *Civil Engineering* students are the same for the second and third years, except that in the second year of the first named, Naval architecture is an additional subject, and in that of Civil Engineering, Geology is an additional subject, and in the third year of Naval Architecture, naval architecture is substituted for Engineering (laboratory), and surveying and practical geology are added to the third year's course in Civil Engineering.

In *Electrical Engineering* the courses of study are similar to the above, except that Electrical Engineering is taken in addition.

The *Mining and Metallurgy Course* for the second year consists of Geology, as required of students of Science in the first year, economic mineralogy, mineral deposits, applied mechanics (junior engineering, engineering (laboratory), mechanical drawing and practical chemistry (two days per week laboratory work). During the third year the subjects studied are mining, surveying, and practical surveying, dressing of minerals, general metallurgy and assaying, engineering (senior course), electrical engineering (junior course), including laboratory work.

Candidates for the degree of M.Sc. must have held the degree of B.Sc. for not less than two years, and are required to satisfy the examiners in some one branch of the scientific subjects professed by the college. They may produce evidence of any original work, either practical or theoretical, in the subject selected for examination since taking the B.Sc. degree. The subjects are practically the same as those for the examination for the B.Sc. only they receive fuller treatment. The M.Sc. is conferred both for pure and applied science.

Candidates for the Degree of D.Sc. must have been in possession of the M .Sc. degree for seven years. It is conferred on a report of an investigation of the claims of the candidate by two examiners specially appointed for this purpose, who shall report to the Board of Examiners in the Faculty of Science on the qualifications of the candidate, *basing their report upon the candidate's distinction in special research or learning.* When making application, the candidate is requested to forward such evidence of his contributions to the advancement of Science as may support his application.

The Title of Mechanical, Mining, or Civil Engineer, of the University of Durham is conferred on Associates or Bachelors in the Faculty of Science, by grace of the University, if they have been engaged for three years in practical work, and subsequently passed a further examination relative thereto.

Students who have passed through the regular Engineering day course of the College are qualified as candidates for appointment as *Probationary Assistant Engineers in the Royal Navy.* Candidates are also prepared for all first-class open competitions for public appointments, including those of the Higher Division of the Home Civil Service, the India Civil Service, the Royal Indian Engineering College, the Public Works, Forests and Telegraphy Services of India, Eastern Cadetships, Student Interpreterships, and others.

Apprenticeship in Engineering.—Arrangements are made so that students may combine the College courses with their apprenticeship. Various engineers and shipbuilders have agreed to co-operate with the College by receiving pupils in the several departments of their works and in their drawing offices, and by permitting them to exclusively devote two or three sessions to study.

14. *Engineering Laboratory, Durham College of Science.*—The laboratory is intended to serve a twofold purpose—first, to afford, in the case of junior students especially, practical illustrations and demonstrations in connection with the subject-matter of the lectures; and second, to provide a means for original research for senior students in various fields of engineering practice. *It is not at all intended as a school for teaching the use of tools,* except in so far as this may be acquired incidentally; nor is it intended to take the place of the usual term of apprenticeship in commercial engineering establishments. The

[1] May be extended over four years in cases where students are unable to undertake it in three.

The equipment is as follows:—Vertical testing machine, capable of testing materials up to 100 tons in tension, compression, shearing, and cross-breaking, worked by a hydraulic intensifier, and fitted with autographic apparatus for recording the relation between stress and strain.

Vertical quadruple expansion, surface-condensing, experimental steam-engines, with four separate cranks, and capable of working up to 200 indicated horse-power. These engines are specially designed and constructed with a view to experiment in almost every possible direction. They can be worked single, double, triple, or quadruple expansion, at any degree of expansion in each cylinder, and various ratios of cylinders and receivers, with various angles of cranks, with or without jackets, and with steam pressures up to 210 lbs. per square inch. A specially designed hydraulic dynamometer is fitted and arranged with gear for autographically recording the effective work transmitted through the shaft. Means are provided for taking indicator diagrams, and for accurately measuring the feed water, the circulating water, and the water condensed in jackets, cylinders, and steam chests.

Multitubular experimental steam boiler of the marine return-tube type, capable of working up to 200 horse-power, and designed for a working pressure of 210 lbs. per square inch.

Horizontal coupled compound steam engines, capable of indicating a horse-power of 200, with steam of 140 lbs. pressure. These engines are primarily intended for driving the dynamo which supplies electricity to light the College buildings, etc.; they are, however, also available for other purposes in the engine-room and laboratory. Double cylinder gas-engines, of 26 indicated horse-power. Compound dynamo, giving 500 amperes at 103 volts. Shafting, with pulleys and speed cones, for driving the laboratory tools, etc., and for testing dynamos, etc. Parsons' turbine motor and dynamo. Testing apparatus for non-conducting compositions. Lathes, 5 inches, 8 inches, and 10 inches. Shaping machine. Pillar drilling machine. Sensitive drill. Band saw. Air compressor. Pressure-gauge testing machine. Various minor tools and appliances.

15. *Art Department, Durham College of Science.*—There is an art department in connection with the College for the study of which day classes and evening classes are provided. The courses of study comprise:—Drawing, painting, and modelling from the living human model; Geometrical drawing; Drawing to scale; Orthographic and perspective projection; The orders of architecture; Gothic mouldings and tracery; Historic styles; Architectural design; Painting in oil and water colours; Theory and principles of ornament; Drawing, painting, and modelling ornament; Historic styles of ornament; Designing the shapes of objects, with construction as basis; Designing the decoration of objects; Designing for trade purposes; Studies of objects of natural history, of heraldic devices, of shields, scrolls, lettering, and other ornamental adjuncts.

The form and construction of the human figure, studies of drapery, costume and armour, etc.; Figure designs and book illustrations.

Prizes are awarded annually, and an Exhibition of students' work is held, which at its close, is sent to South Kensington for submission to the Government National Competition, and the awards are made by artists of recognised eminence.

16. *Special Saturday Classes, Durham College of Science.*—For those who cannot attend on other days and who desire to participate in the advantages afforded by the College, the following courses of study have been provided, viz.:—(1) Mathematics, including theoretical mechanics; (2) Advanced mathematics; (3) Physical laboratory course; (4) Chemistry (laboratory); (5) Botany (laboratory), including physiology of plants treated experimentally; (6) Biology (botanical part); (7) Natural history, zoology and laboratory; (8) Art: blackboard drawing. Studies of common objects, etc., colouring and the use of pigments as employed in imitative and decorative art and drawing, elementary, antique, life. There are also special courses for miners leading to a Certificate after a three years' course; the subjects studied being briefly: Geometry; transmission of power; pumping and ventilation; elements of trigonometry; mine surveying; the management of horses. The following subjects may be taken as illustrating the type of work done during the third year:—Mensuration; the chemistry of fuel; boring and shaft sinking; the principles of geology; experimental mechanics; drifts and levels; the geology of the coalfields; theoretical electricity; exploitation of mines; the chemistry of mine gases and explosives; the steam engine; haulage and winding. For *Colliery engineers, enginewrights, apprentice mechanics,* and others, the Council of the North of England Institute of Mining and Mechanical Engineers and the College have arranged a course of lectures between them. The course of study is somewhat similar to that outlined for miners, with the omission of mathematics.

17. *Evening Classes, Durham College of Science.*—As before stated, the students in the evening classes are also divided into Matriculated and Non-Matriculated students, and the regulations for each are the same as for the students of the day classes. All subjects taught in the College are taught in these classes though not all in the same session, which renders it necessary for students to attend for a longer period if they would complete their curriculum. What has been said in regard to the Title of Associate in Science and the degree of Bachelor in Science applies also to evening students in pure science, though in regard to the applied sciences, the evening courses do not form a substitute for the day classes for either a Certificate or a Degree.

Telegraphy and Telephony; Plumbing; and Typography are subjects taught in the evening classes which do not appear on the programme of the day classes. And the lectures delivered in Building Construction are arranged with a view to preparation for the constructional sections of the examinations conducted by the Royal Institute of British Architects and the Surveyors' Institution.

18. *Technical Instruction, University of London.*—The London University gives degrees in science, in both Agriculture and Engineering. In the former the B.Sc. only, at present, in the latter the B.Sc. and D.Sc. At the time of the Commissioner's visit the London University was being rapidly developed. The work calls for no special comment. The references in the next section will afford a more detailed idea of the type of work undertaken.

19.

19. *Technical Instruction, King's College, London.*—There is a Division of Engineering, Architecture and Applied Sciences in King's College, London. It comprises the following courses, viz.:—

(1) Mathematics; (2) Natural Philosophy; (3) Experimental Philosophy; (4) Course in the Wheatstone Physical Laboratory; (5) Chemistry; (6) Mechanical Engineering; (7) Course in the Engineering Laboratory; (8) Engineering Workshop Course; (9) Mechanical Engineering (evening courses); (10) Civil Engineering; (11) Electrical Engineering; (12) Freehand and Geometrical Drawing; (13) Architecture; (14) The Art and Scientific Principles of Photography; (15) Geology and Mineralogy; (16) Metallurgy.

There are Evening and Saturday Morning Classes for instruction in all these subjects. The Engineering and Architectural courses are each of three years' duration, and, except in the case of Architecture, the first two years are alike for all. The B.Sc. degree of the *University of London* is conferred on matriculated students who have successfully passed through the three years' course. The latter may be also candidates for the College Certificates or Associateship. Non-matriculated students may take any special subject, but cannot obtain a degree.

In the first year of the course in Engineering and applied sciences, the subjects of study are:—Mathematics, chemistry, mechanics, physics, drawing (geometrical and freehand), divinity, workshop, civil engineering, building construction, geology, geological and mineralogical laboratory and library. In the second year the subjects taught are:—Practical chemistry, mechanics, mathematics, physics, physical laboratory, divinity, civil engineering, mechanical engineering, including drawing and laboratory practice, workshops, mineralogy and metallurgy.

In the third year, the subjects are identical for electrical engineering and mechanical engineering, and differ only for civil engineering, in that civil engineering is substituted for electrical engineering; the distribution of time in all three cases is, however, also somewhat different.

For *Mining Engineering*, the following are the third year subjects:—Mechanical engineering lectures with drawing and laboratory practice, civil engineering, electrical engineering lectures with laboratory practice, chemistry, geology and mineralogy lectures with laboratory practice, metallurgy lectures with laboratory.

For *Chemical Technology* the subjects of the third year are:—Chemical laboratory, chemical lectures, physics and physical laboratory practice; and for Metallurgy they are: Metallurgical laboratory and lectures, chemical laboratory and physical laboratory.

The following is the programme of study for the course in *Architecture*:—

First Year.	*Second Year.*	*Third Year.*
Mathematics.	Chemistry.	Specifications.
Mechanics.	Divinity.	Sanitary Science.
Physics.	Building Construction Lectures.	Professional Practice.
Divinity.	Strength of Materials.	History of Ornament.
Geology and Mineralogy.	Theory of Structures.	Architectural Modelling.
Architectural History.	Architectural History.	Building Construction Drawing.
Geometrical and Freehand Drawing.	Land Surveying.	Architectural Drawing.
Building Construction Lectures.	Building Construction Drawing.	Architectural Design.
Building Construction Drawing.	Architectural Drawing.	
Architectural Drawing.		
Carpenter's Shop.		

There is also a special course of one year in Architecture.

20. *Faculty of Science, University of Edinburgh.*—In the University of Edinburgh both pure and applied Science are under the care of the Science Faculty. The courses of study coming under the head of pure science comprise:—

(1) Mathematics; (2) Zoology, including comparative anatomy, comparative embryology, morphology of the vertebrata, and invertebrate zoology; (3) Botany, including botanical laboratory and lectures; (4) Natural philosophy; (5) Chemistry (organic chemistry, advanced chemistry, chemical theory, mineralogy and crystallography, (advanced); (6) Astronomy; (7) Human anatomy, including anthropology; (8) Physiology; (9) Geology, including mineralogy.

The courses in applied Science consist of the following:—

I. *Engineering.*

The instruction is given by means of lectures, drawing, office work, practical work in the laboratories, and visits to engineering works and manufactories.

Students of *Civil Engineering* preparing for the B.Sc. therein take in their first year: advanced or intermediate honour mathematics, chemistry and chemical laboratory, or natural philosophy and laboratory; in their second year, junior engineering and engineering drawing are substituted for mathematics; and in their third year they study senior engineering, engineering drawing, applied mathematics engineering laboratory, geology, or other optional course. Engineering field work is taken in any of the summer sessions.

Students of *Mechanical and Electrical Engineering*, preparing for the B.Sc., are required to study these subjects at the *Heriot-Watt College*, an arrangement to this end having been made between the University and that College. The course of study consists briefly of—course on the theory and practice of the steam-engine and gas and oil engines; course on kinematics and dynamics of machinery; mechanical drawing course; electrical engineering, the subjects of the lectures including a treatment of electrical instruments for the measurement of electromotive force, current, resistance, power, etc.; the testing of magnetic materials; the theory and construction of continuous and alternating current dynamos and motors, transformers, accumulators, arc and incandescent lamps, etc.

II.

II. *Public Health.*

This course comprises (1) preliminary, chemical and physical, and bacteriological work in the laboratory; (2) physics; (3) geology; (4) public health and sanitary science; (5) sanitary engineering, building construction, etc.; and (6) instruction in mensuration and drawing.

III. *Agriculture.*

The subjects to be studied under the course in Agriculture are:—

(1) Mathematics; (2) zoology; (3) botany; (4) natural philosophy; (5) chemistry; (6) agriculture and rural economy, including definition of agriculture, surface geology, drainage and cultivation, implements and machines of the farm, steam cultivation, motive powers employed on the farm, farm servants, importance of rotations, our farm crops, identification of grasses and valuable pasture plants, the management of permanent pasture, weeds in pastures and means of destroying them, manures, buildings and fences, live stock, dairying in all its branches, and feeding stuffs; (7) agricultural chemistry; (8) geology; (9) veterinary hygiene; (10) agricultural entomology; (11) economic science as applied to agriculture; (12) forestry, including experimental physics and engineering; (13) engineering field work. There are also Garton lectures given on the agriculture of the Dominion of Canada, Australasia, and the smaller Crown colonies.

21. *Regulations for Science Degrees, University of Edinburgh.*—The University confers two degrees in Science, viz., the B.Sc. and the D.Sc. These degrees are given both in pure and applied science. In the case of Agriculture, however, the Doctorate in Science is not conferred. Candidates for the degree of Bachelor of Science in Pure Science must adhere to the following conditions:—

(1) They must, unless exempted, before entering on the curriculum pass a preliminary examination in: (i) English; (ii) one of the following:—Latin, Greek, French, or German; (iii) Mathematics; (iv) one of the following:—Latin, Greek, French or German (if not already taken), Italian, or such other language as the Senatus may approve[1]; (v) Dynamics.
(2) They must devote at least three years to study at the University.
(3) They must attend at least seven courses of instruction, four of which must be taken at the University of Edinburgh and the remaining three may be taken at this University or at other Universities or Institutions approved by the University Court, or under teachers recognised by the University Court.
(4) Three of these courses must be in subjects prescribed for the First Science Examination, and are: Mathematics, or Biology (*i.e.*, Zoology and Botany, Lectures and Practical Work); Natural Philosophy; and Chemistry, with practical chemistry.
(5) Four of the courses must be from subjects prescribed for the Final Science Examination, which are as follows:—(*a*) Mathematics; (*b*) Natural Philosophy; (*c*) Astronomy; (*d*) Chemistry; (*e*) Human anatomy, including anthropology; (*f*) Physiology, including histology and physiological chemistry; (*g*) Geology, including Mineralogy; (*h*) Zoology, including comparative anatomy; (*i*) Botany, including Vegetable Physiology.

For candidates for the degree of B. Sc. in engineering the following are the conditions:—

(1) A preliminary examination must be passed of a like nature to that for the degree in pure science, except that the Mathematics must be of a higher standard; and the examination need not necessarily be passed before entering on the curriculum, but must before presentation at the First Science Examination.
(2) Three years at least must be given to eleven courses of study.
(3) Five courses, including those in Engineering, must be taken at the University of Edinburgh, and the remainder may be taken in other Universities or Institutions approved by the University Court, or under teachers recognised thereby.
(4) The courses of study which must be attended are:—

(*a*) Mathematics, including analytical geometry and differential and integral calculus. (*b*) Natural Philosophy, including applied higher mathematics. (*c*) Chemistry. (These form the subjects prescribed for the First Science Examination.) (*d*) A course in the Physical laboratory or in the Chemical laboratory, or of practical chemistry. (*e*) and (*f*) Two courses in practical work in Drawing. (*g*), (*h*), and (*i*) Three courses in Engineering, including engineering laboratory practice and field-work. (*j*) Natural Philosophy, involving higher mathematics. (*k*) One of the following: Engineering laboratory practice, mechanical or electrical (special course); electricity, pure and applied; geology and mineralogy.

The details relating to the degree in Public Health may be omitted.

For *graduation in Agriculture* the following are the conditions:—

(1) The preliminary examination must be passed before the candidate presents himself for any part of the First Science Examination.
(2) Candidates must, during at least three academic years, attend eleven courses of instruction, five of which, including the course in Agriculture and Rural Economy, must be taken at the Edinburgh University; and the remainder may be taken at other Universities or Institutions approved by the University Court, or under teachers recognised by the University Court.
(3) Residence and practical work at a farm of not less than twelve months' duration.
(4) The subjects that must be studied are the following:—

(*a*) Mathematics or Biology (*i.e.*, Zoology and Botany). (*b*) Natural Philosophy. (*c*) Chemistry, including Practical Chemistry. (*d*) Agriculture and Rural Economy. (*e*) Agricultural Chemistry. (*f*) Geology. (*g*) Veterinary Hygiene. (*h*) Agricultural Entomology. (*i*) Economic Science as applied to Agriculture. (*j*) A course in either Forestry, Experimental Physics, or Engineering. (*k*) Engineering, Field Work.

Doctorate

[1] This condition as to languages may now be said to be the general condition.

Doctorate of Science.—To obtain the degree of D.Sc., in either pure or applied science, candidates must have held the degree of B.Sc. from the University of Edinburgh for a term of five years, or the degree of M.A., with first or second class honors in Mathematics and Natural Philosophy, for the same period of time.

This degree is never conferred *honoris causa tantum.*

22. *Heriot-Watt College, Edinburgh.*—Reference was made in a preceding paragraph to the Heriot-Watt College of Edinburgh. This college is essentially an institution for technical education, attention being given to both the lower and higher forms of technology. There are also commercial classes, and a section for literature, music, and languages. The provision made endeavours to meet the practical educational needs of the community; the requirements of a variety of professional callings and trades are in its scheme. An idea of the character of the instruction may be obtained from the following brief account:—

Higher and lower technical instruction is given in (*a*) Day Classes, (*b*) Special Classes, and (*c*) Evening Classes.

The Day Classes.—These classes are arranged for the training of mechanical and electrical engineers and manufacturing chemists, and are recognised by the University of Edinburgh; so that students can take their B.Sc. degree by attending certain additional classes in the University. A two-years' course qualifies for an *Intermediate Certificate*, and a three-years' course for the *Diploma* of the College. For the latter an entrance examination is necessary, of which the subjects must be: (1) English composition and writing to dictation. (2) Mathematics, including arithmetic, geometry (Euclid, first three books or their equivalent), algebra (to easy quadratic equations). (3) Freehand drawing (second grade) and elementary geometrical drawing. (4) Elementary physics, or any one of the following languages, viz., French, German, Latin, or Spanish, including translation into English, with questions on grammar and translation of simple English. Those who have passed the London University Matriculation Examination, the Scottish University Preliminary Examination for Science Degrees, are exempted from this examination. The three-years' course for the Diploma may either be attended entirely at the College, or partly at the College and partly at the University (of Edinburgh); but for the B.Sc. degree in Engineering, part of the course *must* be received at the University. The final examination, on which the obtaining of the Diploma depends, must be in one of the following groups:—

Group I. *Mechanical Engineering.*—Engineering, higher standard. Mathematics, higher standard. Physics, pass.

Group II. *Electrical Engineering.*—Electricity and Electrical Engineering, higher standard. Mathematics, higher standard. Physics, pass. Mechanical Engineering, pass.

Group III. *Chemistry.*—Pure Chemistry, higher standard. Mathematics, pass. One branch of Applied Chemistry, higher standard; or Physics, higher standard; or Electrical Engineering, higher standard.

The courses of study are as follows:—

In the *Engineering Courses*, there is first of all a general *Course in Mechanics* for all engineering students, the subjects of study being kinematics, dynamics, statics, and hydrostatics, given by means of lectures, tutorial work, and laboratory practice.

The course in *Mechanical Engineering* comprises:—(*a*) Lectures and exercises on engineering principles and work. (*b*) Instruction in machine and geometrical drawing. (*c*) Experimental work in the engineering laboratory. During the first year, the time is devoted to elementary principles of engineering, including mechanics of machinery, constructive materials, strength of materials, and steam, gas and petroleum engines. During the second year, the theory and practice of the steam-engine and gas and oil engines; kinematics and dynamics and friction machinery; hydraulics; and a half-course on the strength of materials (to be taken at the University) are studied. Students in the third year are occupied with the higher branches of the subject, such as will qualify them to take leading positions in the engineering profession. Additional time is devoted to engineering laboratory and research.

The Engineering Laboratory is provided with a Greenwood and Batley 50-ton horizontal testing machine, arranged for tensile, compressive, transverse, and shearing tests; a Wicksted torsion-testing machine, capable of exerting a twisting moment of 12,000 pounds-inches; a cement testing machine; oil-tester; axle friction testing machine; tank fitted for hydraulic experiments; centrifugal pump arranged for experimental purposes, etc.

A small wind furnace is provided, in which students may make experiments on the composition of the various alloys used in engineering construction.

Mathematics, of course, is taken throughout the years; mechanical drawing and handicraft is taken in the first two years, and sometimes in its advanced stage it is required to be taken in the third year.

Course in Electrical Engineering and Physics.—This course is of three years' duration. The first year is devoted to physics, consisting mainly of lectures and laboratory practice in electricity and magnetism, in heat, properties of matter, light and sound. In the second year, the various branches of physics are continued with more advanced treatment, and electrical engineering and technology are taught. During the third year, the subjects for study are—Mathematics (which are also taken in the two previous years), engineering, physics (including lectures on electricity, heat, properties of matter, light, and molecular physics), electrical engineering and laboratory and drawing.

The electrical engineering laboratory is equipped with machinery and apparatus for experimental work in continuous and alternating currents, for the standardising of instruments, and the testing of materials, machines, and apparatus.

Course in Chemistry.—The instruction given in this course in the first year consists mainly of *lectures*, arranged so as to lead up to a knowledge and understanding of the general laws of chemical action; of *laboratory practice*, a practical acquaintance with the physical properties and chemical behaviour of some of the more important elements and their chief compounds being aimed at; also the combination of qualitative observation with quantitative measurement; and of *mathematics*, including algebra, trigonometry, calculus, and practical mathematics. In the second year, lectures are given in organic chemistry, and the elements of physical chemistry. In the laboratory the student is chiefly engaged in acquiring a practical knowledge of systematic analysis, and in the study of the reactions of the various

metallic

metallic and salt radicals. The mathematics are divided into sections, viz., mathematics, mechanics, friction, and graphic statics. During the third year, the time is principally devoted to work in the laboratory, with such special classes in applied chemistry as are suitable to the individual needs of students. Courses in paper manufacture, gas manufacture, shale distillation, brewing, etc., are arranged, and students desiring to qualify as electro-chemists receive special instruction. Geometrical drawing is taught in the first year only.

Civil Engineering.—The first year may be taken at the College, and the remaining two years at the University in obtaining the B. Sc. degree.

23. *Special Classes, Heriot-Watt College, Edinburgh.*—These classes are intended for agricultural students, and are in connection with the Edinburgh and East of Scotland College of Agriculture. The courses comprise—(1) Land Surveying, with field exercises in chain survey work and for practice with level and theodolite. (2) Agricultural Engineering, the object of which is to impart a general knowledge of engineering as directly applied to agricultural work, given by means of lectures and practical work and demonstrations in the engineering laboratory and workshops; the strength and properties of materials used in construction, the conversion of motion, mechanics of agricultural machinery, the steam-engine, boilers, gas and petroleum engines, water-power, electrical apparatus, mechanical drawing, building construction, and handicraft (metal work) are treated of. (3) Bacteriology, the lectures and practical laboratory work consisting of—definition and classification of bacteria, bacteriological methods and technique, water, milk, soil, and bacterial diseases of animals. (4) Agricultural Botany, including the vegetative and reproductive organs, the life-histories of plants and practical work in the laboratory. (5) Natural History, dealing specially with the Protozoa and Metazoa, worms, insects, centipedes and millipedes, spiders and mites, mollusca, birds and mammals.

24. *Evening Classes, Heriot-Watt College, Edinburgh.*—To enter these classes a simple entrance-examination is required of candidates, unless they already possess a Merit Certificate from an Elementary Day School, or a certificate of sufficient attainment from an Evening Continuation School, or have attended at least one year at the Senior Classes at a recognised Secondary School, or are over 20 years of age. Diplomas are awarded provided students go through the same course of study as that set forth in the day classes, and certificates also are conferred. The following classes and list of subjects taught in each afford an indication of the range and extent of the instruction provided.

(I) *Preliminary Classes* for English and Arithmetic.

(II) *Technological and Science Classes.*

(i) *Engineering* (mechanical, electrical, civil, and mining):

A. *General Course—Elementary.*
Elementary mensuration; mathematics—Stage I; Geometrical drawing—Part I; physics; chemistry, inorganic (elementary); applied mechanics (elementary); prime movers (elementary); handicraft (metal work).

B. *Mechanical Engineering—Advanced.*
Mathematics—Stage II; Geometrical drawing—Part II; machine construction and drawing (advanced); applied mechanics (advanced); prime movers (advanced); graphical calculation (advanced); chemistry, inorganic (advanced).

C. *Mechanical Engineering—Honours.*
Mathematics—Stages III, IV, V; Geometrical drawing; applied mechanics (honours); machine construction (honours).

D. *Electrical Engineering—Advanced.*
Mathematics—Stage II; machine construction (advanced); applied mechanics (advanced); prime movers (advanced); electricity and magnetism (advanced); graphical calculation (advanced); electrical engineering (ordinary); telegraphy and telephony (ordinary).

E. *Electrical Engineering—Honours.*
Mathematics—Stages III, IV; electricity and magnetism (honours); electrical engineering (honours); telegraphy (honours); chemistry, inorganic (advanced).

F. *Civil Engineering.*
Mathematics—Stages II, III, IV; Geometrical drawing (advanced); applied mechanics (advanced); graphical calculation (advanced); land surveying and levelling; geology; quantity surveying.

G. *Mining Engineering.*
Land surveying and levelling; geology; principles of mining.

(ii) *Chemistry* (General, pharmaceutical, technical):

A. *General Chemistry.*
Inorganic chemistry—Stage I; inorganic chemistry—Stage II; organic chemistry—Stage I; organic chemistry—Stage II; Honours chemistry—Stage I; Honours chemistry—Stage II; (Additional course recommended: Mathematics—Stages II and III; and physics; elementary electricity.)

B. *For Manufacturing Chemists.*
Machine construction and drawing; applied mechanics (elementary); prime movers (elementary; mathematics—Stages I, II, and III; electricity (advanced).

(iii) *Building Construction* :
Architecture and building construction (elementary, advanced, and honours); Geometrical drawing; mathematics—Stages I and II; applied mechanics (elementary); quantity surveying; sanitary science; strength and materials.
Supplementary Trade Classes:—Carpentry and joinery, masonry and brickwork, plumbers' work.

(iv) *Agricultural Classes*:

Agriculture; elementary mensuration; botany; zoology; handicraft—metal work; mathematics, Stage I; elementary, theoretical, and practical inorganic chemistry; agricultural chemistry; entomology; horticulture; applied mechanics; veterinary science, and land surveying and levelling.

(v) *Sanitary Science*:

Sanitary science—elementary and advanced; inorganic chemistry (theoretical and practical—elementary); physics; mathematics—Stage I; building construction (elementary); veterinary science; physiology; hygiene; miscellaneous science classes.

(III) *Commercial Classes.*

(i) *Elementary*:

Commercial arithmetic; shorthand; book-keeping; French (elementary); German (elementary); English language and composition; commercial correspondence and precis writing.

(ii) *Advanced*:

Industrial and commercial geography; economic science; practice of commerce; principles of accounting and insurance: banking and banking law; commercial law; book-keeping (senior); Spanish; French and German (advanced and commercial); commercial history· algebra for actuarial students.

(IV) *Art and Trade Classes.*

Geometrical drawing; drawing and painting; modelling; principles of ornament and design; book illustration; house painters' and decorators' work (drawing and design); Photo-methods for book illustration (chemistry); lithography (drawing and design); watch and clock making (Mathematics, Stage I); cabinet making (geometrical drawing and building construction); plumbers' work (sanitary science); carpentry and joinery (geometrical drawing and building construction); masonry and brickwork (geometrical drawing and building construction); electrical engineering—elementary (electricity and magnetism).[1]

(V) *History, Literature, Music, and Language.*

English literature and composition, Latin, Greek, elocution, theory of music.

In each subject there is usually (i) an elementary; (ii) an advanced; and (iii) an honour course.

25. *Laboratories and Workshops, Heriot-Watt College.*—The college is provided with mechanical and engineering laboratories, and iron and wood workshops, fitted up in a fairly complete manner. The mechanical laboratory is equipped with apparatus for illustrating and verifying the laws of mechanics and hydrostatics, for experiments on friction, etc. In the engineering laboratory there is a Greenwood and Batley 50-ton horizontal testing machine, arranged for tensile, compressive, transverse, and shearing tests; a Wickstead torsion testing machine, capable of exerting a twisting moment of 12,000 pounds-inches, a cement testing machine, oil tester, fuel tester, gas and oil calorimeter, axle-friction testing machine, etc. There is also a large compound steam engine and locomotive boiler, arranged for and fitted with all the necessary apparatus for complete tests of engine and boiler efficiency, etc. The engine is designed to work compound, simple expansion, condensing or non-condensing, and with varying crank angles. Tanks are arranged so that the feed and condensing water can be accurately measured. Brakes and all needful indicator apparatus are part of the equipment, and there are thermometers and gauges attached at all needful points. The laboratory is also provided with a very efficient 5-brake horse-power petroleum engine, with all necessary appliances for making tests. The large gas engine used for driving the machinery in the iron workshop is also arranged for experimental work.

The iron workshop is fitted with screw-cutting and other lathes, shaping machine, milling machine, drilling machines, planing machine, vice benches, etc., power being supplied by the steam and gas engines.

The wood workshop, besides benches, is supplied with lathes, saw bench, mortising machine, etc., power being derived from a gas engine.

It has already been stated that this College affords some assistance in the way of providing workshop practice for the students.

26. *Faculty of Science, University of Glasgow.*—The Faculty of Science embraces the following subjects, viz.:—Mathematics, natural philosophy, astronomy, chemistry, natural history (including geology and zoology), botany, anatomy, physiology, civil engineering and mechanics, naval architecture, pure and applied electricity, electrical engineering, metallurgical chemistry and agriculture. As the courses in applied science of this University are within the province of technology, each one will be briefly referred to. These courses consist of the following, viz.:—

(I) *Civil Engineering and Mechanics*, comprising lectures on engineering principles and practice, instruction in geometrical drawing and in engineering drawing and calculations, laboratory practice, and visits to engineering works and manufactories.

These courses are designed primarily to suit students who intend to devote themselves to civil, mechanical, electrical, or mining engineering; but they are also recommended to architects, and to such as are, or intended to be, engaged in any occupations connected with manufactures.

(II) *Electrical Engineering.*—Instruction in this Department is given by means of lectures treating of units, magnetic properties of iron, magnetic circuits, design of electro-magnets, electro-magnetic induction; and also by dynamos and motors and alternating currents.

(III) *Naval Architecture including Marine Engineering*, which comprises a junior course of lectures and examinations upon naval architecture and marine engine and boiler design, and a senior course of lectures and examinations upon naval architecture and marine engine design; also a junior and a senior course of instruction in ship drawing and calculations and marine engine drawing and design.

(IV) *Agriculture.*—This course need not be here specially referred to. 27.

[1] The bracketed subjects signify supplementary classes for the benefit of trade and art students.

27. *Regulations for Degrees in Pure and Applied Science, University of Glasgow.*—The degrees conferred for pure and applied science are those of Bachelor of Science (B.Sc.) and Doctorate of Science (D.Sc.). To obtain the former in either pure science, engineering science, or agricultural science, the following are some of the conditions, viz.:—

(1) Candidates must pass a preliminary examination in English, Latin or Greek, or French, or German; higher mathematics; one of the following:—Latin or Greek (if not already taken), or French, German, or Italian (or such other languages as the Senatus Academicus may approve), dynamics.
(2) The possession of a degree in arts from any British, colonial, or foreign university, recognised as equivalent by the University Court, will however exempt from this preliminary examination.
(3) Three academic years must be taken at the University.

For *pure science*, seven courses of instruction must be attended during the three years, three of which, however, may be taken in other Universities or institutions, or by teachers approved by the University Court. The three courses prescribed for the first science examination, viz., (1) mathematics or biology (*i.e.*, zoology and botany); (2) natural philosophy; (3) chemistry, must be taken, and any four of the following subjects prescribed for the final science examination, viz., (1) mathematics; (2) natural philosophy; (3) astronomy; (4) chemistry; (5) human anatomy, including anthropology; (6) physiology; (7) geology, including mineralogy; (8) zoology, including comparative anatomy; (9) botany, including vegetable physiology.

For *Engineering Science*, nine courses of instruction must be attended during the three academical years, five of which are to be taken in this University,—one being a course in engineering; and four may be taken in other Universities or institutions approved by the University Court, or under teachers recognised thereby. The courses are as follows:—

(1) Mathematics, including analytical geometry, and differential and integral calculus.
(2) Natural philosophy, including applied and higher mathematics.
(3) Chemistry.
(4) A course in the physical laboratory, or in the chemical laboratory, or of practical chemistry.

and either:—

(5), (6) Two courses in engineering, including laboratory practice.
(7), (8) Two courses or practical work in drawing.
(9) A course in one of the following:—

(*a*) Astronomy and geodesy. (*b*) Geology and mineralogy. (*c*) Naval architecture. (*d*) Engineering laboratory, mechanical or electrical (special course.) (*e*) Electricity, pure and applied.

or:—

(5), (6) Two courses in Naval Architecture with Marine Engineering.
(7), (8) Two courses of practical work in ship and engineering drawing.
(9) A course in engineering, including laboratory practice.

For "*Science in Agriculture*," twelve courses of instruction must be attended during the three academical years, some of which, however, are full and others only half courses. Five full courses or their equivalent, one of which must be the course "in agriculture and rural economy,"[1] are required to be taken in the University of Glasgow; the remainder may be taken in other Universities or institutions approved by the University Court. The courses of study are as follows:—

(1) Mathematics or Biology (*i.e.*, Zoology and Botany).
(2) Natural Philosophy.
(3) Chemistry.
(4) Agricultural and Rural Economy.
(5) Agricultural Chemistry.
(6) Geology.
(7) Veterinary hygiene.
(8) Agricultural Botany.
(9) Agricultural Entomology.
(10) Economic Science as applied to Agriculture.
(11) One of the following:—

(*a*) Forestry. (*b*) Experimental physics. (*c*) Engineering.

(12) Engineering Field-work.

The conferring of the Degree of *Doctorate of Science* (D. Sc.) is dependent on the following conditions:—

(1) Candidates must have held the degree of B.Sc. for a period of five years, *or*
(2) Have held the degree of Master of Arts in any Scottish University, with first or second-class honours in Mathematics and Natural Philosophy, for five years.
(3) The presentation of a thesis, or a published memoir or work approved by the Senatus.
(4) The passing of an examination, if required by the Senatus, from time to time.
(5) The thesis for the D Sc. in Engineering, shall be a record of original research, undertaken by the candidate, or of important engineering work designed by himself, and actually carried out, and shall be accompanied by a declaration, signed by him, that these conditions have been satisfied.

These regulations apply only to the D. Sc. degrees in pure Science, and in Engineering; the B.Sc. degree only is conferred in the case of "science in agriculture."
Besides the degrees, there are also Certificates of Proficiency awarded in Engineering Science.

28.

[1] This course may also be taken provisionally in the Glasgow and West of Scotland Technical College.

28. *Technical Instruction, Royal University of Ireland.*—Besides courses in Science, there is a Civil Engineering course and a course in Agriculture, and one in Sanitary Science, in the Royal University of Ireland. The degrees in Civil Engineering are Bachelor and Master—a diploma is also given. In Agriculture a diploma is given, also in Sanitary Science; but the diploma in this last instance is conferred only upon graduates in medicine.

For the Bachelor degree in *Civil Engineering* the matriculation examination and first university examination must be first passed. The latter takes place one academical year after matriculation. Then there are the first and second professional, and the degree examinations. The subjects are:—

1st Professional Exam.	*2nd Professional Exam.*	*Degree Exam.*
Mathematics.	Mathematics.	Mathematical Physics.
Experimental Physics.	Mathematical Physics.	Geology, including Physical Geography.
Systematic Chemistry.	Practical Chemistry.	Civil Engineering, including Mensuration.
Drawing and Descriptive Architecture.	Practical Engineering.	Drawing.

The mathematical physics in the degree examination is the same as for *honours* in arts (in the second University examination); and the geology is the same grade as the corresponding *pass* in arts.

The Civil Engineering is divided into the compulsory and optional groups, viz.:—

Compulsory.	*Optional.*
(a) Strength of materials, stresses, strains, graphics.	(e) Railway engineering.
(b) Surveying, levelling, mensuration.	(f) Harbours, docks, canals.
(c) Drawing.	(g) Waterworks.
(d) Structure of railways and roads (elementary.)	(h) County and municipal work.
	(i) Electrical engineering.

The candidate, to obtain his degree, must pass in *all* the compulsory, and in any *two* of the optional subjects.

The B.E. degree involves four years. Candidates for the M.E. can present themselves one year after obtaining the B.E. They must have spent one year under an engineer in practice, and must pass an examination in (i) Applied Natural Philosophy, and in (ii) Engineering.

The course in Agriculture is a very good one. The examinations include the following subjects, viz.:—

First Exam.	*Second Exam.*	*Diploma Exam.*
Book-keeping	Agricultural Chemistry	Geology
Mathematics.	Botany and Zoology	Veterinary Hygiene
Natural Philosophy	Animal Physiology	Economic Agronomy
Chemistry	Land Surveying.	Agriculture
Botany and Zoology		Horticulture
Land Surveying.		Forestry.

29. *Agricultural Courses, University College of Wales, Aberystwyth.*—The instruction in agriculture given in the University College at Aberystwyth is divided into courses, which vary in length and character according to the circumstances and special requirements of different classes of students. They comprise (1) the Degree Course; (2) the Diploma Course; (3) an Advanced Course in Agricultural Chemistry; (4) Short Courses for Farmers; (5) Courses for Teachers; (6) Courses of Instruction in Dairying. In the following account a brief indication is given of each:—

(1) *The Degree Course* qualifies candidates to present themselves for examination for the B.Sc. degree of the University of Wales, and extends over three academic years. It is open to candidates who have matriculated in the University. It provides a training suitable for land owners, land agents, teachers, farmers, and specialists (such as agricultural chemists), who may wish to take a University degree in subjects bearing upon agriculture and rural economy. The subjects of study for the first year are:—

Chemistry, biology, physics or mathematics.

During the two subsequent years they are:—

Elementary logic, agricultural science, comprising agriculture, agricultural chemistry, and any three of the following subjects, viz.,—entomology, veterinary hygiene, bacteriology, land-surveying, agricultural law, economics, either inorganic and organic chemistry or organic chemistry, botany, zoology or botany, together with special one-year courses in organic chemistry and geology.

(2.) *The Diploma Course* is provided for candidates who have not matriculated, or who are not prepared to devote so much time to the study of pure science. The course is three years, but students are only required to attend two terms of lectures and do two terms of practical work per year. The College Diploma of "Associate in Agriculture" is conferred at the end of three years if the courses have been successfully followed, and the examinations passed. During the first year the subjects of study are: Agriculture, inorganic chemistry, animal physiology, arithmetic and mensuration, the Welsh language, veterinary science, book-keeping, economics, and twenty-four weeks' farm work. The subjects of study for the second year are Agriculture, organic and agricultural chemistry, book-keeping, botany, geology, practical dairying, surveying, geology and physics, and twenty-four weeks' farm work. For the third year they are: Mathematics, mechanics, surveying, drawing, estate management, forestry, agricultural law, engineering, agricultural botany, entomology, and economics.

This course is also recommended to those preparing for examination for the National Diploma in Agriculture, the Professional Associateship of the Surveyors' Institution, and other similar examinations. The standard for the Diploma is, of course, much lower than for the Degree.

(3.)

(3.) *An Advanced Course in Agricultural Chemistry.*—This course, which is mainly practical, is intended for those who wish to make a special study of the subject. It is open to graduates in agricultural science and to those who have taken the College Diploma.

(4.) *Short Courses for Farmers.*—These courses are for the purpose of providing technical instruction for those who already have some knowledge of practical agriculture. There is an elementary class and an advanced class, which meet in the winter months, the former lasting seven weeks only, the subjects of study being: Agriculture (fifty lectures, treating of the soils, manures, crops, live stock, and dairying); chemistry (twenty lectures, on matter, water, air, common salt, limestone, organic matter, and twenty hours' practical work in the laboratory); mathematics; animal physiology (ten lectures); the economics of agriculture (seven lectures); and an optional course in Welsh. The advanced course continues for twenty-two weeks, and is in reality a continuation of the elementary course, the subjects of that course receiving fuller development; and veterinary medicine and surgery, physics, botany, geology, land-surveying, and book-keeping being taught in addition. There is also a supplementary course in Welsh.

(5.) *Courses for Teachers.*—For teachers, special courses in agriculture, chemistry, and horticulture are given on Saturdays.

(6) *Courses of Instruction in Dairying* of the following characters are given, viz.:—

(i) *An Elementary Course in Travelling Dairy Schools* is given at various local centres and continues for two or more weeks, during which time the theory and practice of butter-making, or cheese-making are taught. Certificates of proficiency may be obtained by passing an examination at the end of the course.

(ii) *An Advanced Course at the Dairy of the University College of Wales* continues for eight weeks, and is designed for those already possessing the elementary certificate of the College and who desire to qualify for the Advanced Certificate. The course consists of butter-making (during the course each scholar is expected to turn out at least ten satisfactory samples of prime fresh butter), practical instruction in cheese-making, and instruction in dairy theory.

(iii) *The Teachers' Course in Theoretical Dairying* continues for ten weeks, during which time the subjects of instruction are:—

Chemistry (lectures, demonstration, and laboratory practice); botany (lectures and demonstrations); bacteriology and fungology (lectures and demonstrations); animal physiology (ten lectures); and dairying (twenty lectures). This course is primarily for those students who desire to qualify for the "Dairy Teachers' Certificate," or for the National Diploma in Dairying.

The Dairy Teachers' Certificate is awarded to those students who have received practical instruction for eight weeks in butter-making and cheese-making, who have attended the ten weeks' course of lectures outlined above, and who have passed the examination at the end of the course.

The National Diploma in Dairying is granted by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland. The requirements are:—

(*a*) A general knowledge of all matters connected with the management of a dairy farm, including the rearing and feeding of stock.
(*b*) A thorough acquaintance, both practical and scientific, with everything connected with the management of a dairy, and the manufacture of butter and cheese.
(*c*) Practical skill in dairying, to be tested by the making of butter and cheese.
(*d*) Capacity for imparting instruction to others.

Extension lectures and demonstrations in agriculture are given in various districts on such subjects as the following:—

(1) The growth and requirements of plants; (2) manures and manuring of garden crops; (3) management of garden soils; (4) plants and their environments; (5) allotment gardening for pleasure and profit; (6) a model cottage garden; (7) hardy fruits; (8) bush fruits; (9) strawberries and raspberries; (10) salads; (11) roses; (12) the flower garden; (13) potatoes; (14) the cabbage family: (15) peas and beans; (16) leeks and onions; (17) garden root crops; (18) flowering bulbs; (19) tomatoes; (20) diseases and pests; (21) sea kale, asparagus, and celery; (22) window gardening; (23) budding and grafting; (24) propagation of plants; (25) management of bees; (26) hints for making hives and appliances; (27) Queen rearing and introducing; (28) manipulating bees; (29) feeding, stimulating, and forcing bees; (30) ripening, grading, and marketing honey.

30. *Courses in Agriculture, University College of North Wales, Bangor.*—Instruction in this department of applied science is given by means of "in-college courses" and by "out-college work." The in-college courses comprise the following:—

(1) A two years' diploma course; (2) an advanced course in agricultural chemistry of one year's duration; (3) a one year's course; (4) special courses of ten weeks each; (5) third year's course for day training students; (6) a course covering one year for dairy teachers and those desiring an advanced knowledge of dairy work; (7) a three years' course leading to the degree of B.Sc.

For the *Two Years' Diploma Course*, each of which is divided into three terms, the subjects of study for the first year are:—

Agriculture, farm classes, chemistry, mechanics, botany, geology, botanical laboratory, land surveying, chemical laboratory, entomology. For the second year they are:—

Agriculture, farm classes, zoology, architectural drawing and building construction, book-keeping, chemical laboratory, zoological laboratory, veterinary hygiene, agricultural botany, agricultural chemistry, heat, architectural drawing and building construction, botanical laboratory and agricultural engineering.

Certificates must be obtained in all the subjects before the diploma is awarded.

The

The *Advanced Course in Agricultural Chemistry* is for those who desire to specialise in agricultural chemistry after having attended the two years' course above outlined. It is of one year's duration, and includes the following subjects, viz.:—Agricultural chemistry, organic chemistry, chemical laboratory for eighteen hours per week. Students after a successful completion of this course are entitled to an additional diploma.

The *One Year Course* is intended for students who are unable to take the full two years' course and consists of a selection of classes therefrom.

The *Special Courses* continue for two terms which are each of ten weeks' duration. The subjects treated of are agriculture, farm classes, chemistry, land surveying, agricultural chemistry, and book-keeping.

The *Third Year's Course for Day Training Students* is a special course for those who desire to specialise in their third year in agriculture and subjects specially connected with the curriculum of rural schools.

The *Course for Dairy Teachers and those desiring an advanced knowledge of dairy work*, covers one term, on a satisfactorily completion of which a special certificate is awarded. The subjects of study comprise dairy farming, chemistry, chemical laboratory, physiology, physiological laboratory, and book-keeping.

A Three Years' Course leading to the Degree of B.Sc.—Prior to entering upon this course the matriculation examination of the University of Wales, of which this is one of the constituent colleges, or an examination recognised by the University as equivalent, must be passed. The subjects of study are divided into *Intermediate Courses* and *Final Courses.* The examinations in the intermediate courses, which are chemistry, botany or zoology, physics, and either elementary logic or engineering drawing, are held at the close of the first year, while at the termination of the third year the examinations in the final courses take place, viz., in agricultural science, *i e.*, agriculture, agricultural chemistry, and three of the following five subjects: land surveying, architectural drawing and building construction, veterinary hygiene, entomology, and law of landlord and tenant; and one of the following groups of courses in pure science:—(1) organic and inorganic chemistry; (2) organic chemistry, botany, and zoology—any *two*; (3) organic chemistry, with botany and zoology as subsidiary subjects; (4) botany, with organic chemistry and zoology as subsidiary subjects.

The Agricultural Department of the University College of North Wales is recognised by the Surveyors' Institution as an approved college of professional instruction.

A *Professional Associate of the Surveyors' Institution* must sit for the Students' Proficiency Examination held by that institution, after passing its preliminary examination, and devoting two years to the study of agriculture in the University College of North Wales.

For the purpose of promoting *out-college instruction in agriculture*, the College and the five County Councils of Anglesey, Carnarvonshire, Denbighshire, Flintshire, and Montgomeryshire, have co-operated. The County Councils raise an annual sum of about £1,100, which is divided nearly equally between the various counties, and is expended in various ways, such as butter-making competitions, field experiments, exhibitions, extension lectures, and scholarships.

There are facilities afforded for extension work in agriculture by the University College of the following description:—(1) For dairy instruction there are two dairy-schools maintained by the College, and three fully-equipped travelling dairies. (2) Classes for the instruction of schoolmasters in subjects bearing upon agriculture. (3) Local classes in agriculture. (4) Extension lectures by members of the College staff; and (5) field experiments supervised by members of the College staff.

31. *Course in Electrical Engineering, University College of North Wales, Bangor.*—This course is of two years' duration, and is given by means of lectures, experimental work, and laboratory practice. It is suitable for those who desire to become electrical engineers. The course of study is as follows:—

First Year.

Lecture Courses.—Mechanics. Physics (mechanics, heat, electricity, and magnetism, including electric units and sketch of dynamo-electrical machinery).

Laboratory Courses.—Elementary physical measurements (use of balance, barometer, thermometers, etc.). Easy qualitative work in electricity and magnetism. Electric and magnetic measurements.

Second Year.

Lecture Course.—Electric and magnetic principles and measurements. Theory, practical use, and testing of dynamos, motors, and transformers. Electric lighting, transmission and distribution of power. The steam-engine and other heat-engines.

Laboratory Course.—More advanced electric and magnetic measurements, including determination of magnetic quality in various specimens. Management of machinery. Experimental determination of dynamo constants and characteristic curves. Measurement of electric power and efficiency in electric light and other circuits.

For a full training, practical work in a large factory, where all departments of electrical engineering are represented, would be necessary.

This is the only Engineering course given in this College.

The requirements of the University of Wales for the B.Sc. Degree in Engineering Science are given in the account immediately following of the University College of South Wales and Monmouthshire, another constituent College of the University.

32. *Engineering Courses, University College of South Wales and Monmouthshire, Cardiff.*—These courses include instruction in (1) Engineering Drawing; (2) Engineering Drawing and Machine Design; (3) Applied Mechanics and strength of materials; (4) Mechanical Engineering; (5) Civil Engineering; (6) Surveying; (7) Electrical Engineering and Mechanical Laboratory. There is also a course in Mining.

The courses are of three years' duration, at the termination of which, if the examination at the end of each academic year has been passed, the degree of B.Sc. is conferred by the University of Wales on matriculated students. Students follow the courses of the affiliated colleges, but the examinations are held at, and the degrees conferred by, the University itself. The

The subjects for the intermediate examination include three or four of the following:—Mathematics, physics, chemistry, and either botany or zoology. For the final examination the subjects of study must be one of the following groups:—

Mechanical Engineering Group, comprising:—

(*a*) Pure and applied mathematics, including rigid dynamics.
(*b*) Applied mechanics and strength of materials.
(*c*) Mechanical engineering.
(*d*) Machine design and practical thermodynamics.
(*e*) Engineering drawing.

Civil Engineering Group, comprising:—

(*a*) Pure mathematics or applied mathematics.
(*b*) Applied mechanics and strength of materials.
(*c*) Surveying and setting out works.
(*d*) Theory and design of structures.
(*e*) Geology.
(*f*) Engineering drawing.

Electrical Engineering Group, comprising:—

(*a*) Pure and applied mathematics.
(*b*) Physics (heat, electricity, and magnetism).
(*c*) Applied mechanics and strength of materials.
(*d*) The steam-engine and other prime movers.
(*e*) Applied electricity.
(*f*) Engineering drawing.

Mining Engineering Group, comprising:—

(*a*) Geology.
(*b*) Mechanical engineering.
(*c*) Surveying.
(*d*) Mining.
(*e*) Engineering drawing.

Metallurgical Science Group, comprising:—

(*a*) Inorganic chemistry.
(*b*) Metallurgy.
(*c*) Geology.
(*d*) Engineering drawing.

Agriculture and Rural Economy Group, comprising:—

(*a*) Agricultural science.
(*b*) *Either* (1) Organic chemistry and inorganic chemistry;
or (2) Two of the following subjects:—Organic chemistry, botany, zoology;
or (3) Organic chemistry, together with two of the following, pursued as subsidiary subjects: Botany, zoology, geology;
or (4) Botany, together with two of the following, pursued as subsidiary subjects: Organic chemistry, zoology, geology.

The buildings of the Engineering Department comprise a large and well-lighted drawing-office, lecture-room, library, testing-house, mechanical laboratory, and workshop.

During the first two years students should devote their time principally to all the various branches of drawing, and the principles of applied mechanics and mechanical design. During the third year, students are permitted and encouraged to specialise in particular branches.

Course in Public Health and Hygiene.—The programme of study is as follows:—In the first year, the subjects studied are physics, practical physics, elementary physics, chemistry, chemical philosophy, practical chemistry, biology, practical biology, anatomy, anatomy demonstration, materia medica. For the second year the subjects are anatomy and anatomy demonstration, physiology, histology, practical and organic chemistry, and materia medica. During the third year instruction is given in anatomy, anatomy demonstration, physiology (elementary and advanced), chemistry (practical and organic), pharmacology, and advanced histology.

There is a *Training School of Cookery and Domestic Arts* in the College. The school is under the management of a Committee appointed by the Council of the College. It is under Government inspection. Students are prepared for the Diplomas of the Board of Education in Cookery, Laundry Work, and Housewifery, and for the Diplomas granted by the Committee, with the approval of the Board of Education.

33. *General Observations on the Technical Courses in British Universities.*—In general it may be said that the condition that a knowledge of Latin or Greek shall be demanded has been abandoned. The preparation at entrance on the technical or professional courses is less thorough than in Europe generally. There is considerable variety in the development of the courses in the different universities. In some cases there is an insufficiency in the opportunity for specialisation.

The necessity for good equipments for teaching professional courses is growing rapidly, and recent extensive additions to apparatus equipments at the time of the Commissioner's visit in the case of most of the universities disclosed the growing recognition of the importance of a sound and liberal scheme of higher technical education.

Reference will now be made to a lower grade of technical instruction.

The Municipal School of Technology, Manchester.—The Municipal School of Technology of Manchester is one of the most finely-equipped institutions in the United Kingdom. It exists for the purpose of providing instruction and training in the principles of science especially in their application to the Industrial Arts, and with a view to imparting a just understanding of the foundations upon which these arts rest, and in this way to promote their best development. The School has Technical Day Courses, Special Courses, Day Classes for Women, and Evening and Saturday Classes, and gives its instruction by means of lectures, laboratory and shop work, together with scientific research directed to the solution of industrial problems.

The conditions of admission to the Day Classes are that the candidate must be not less than 15 years of age; must produce a reference from the school previously attended, and pass the Entrance Examination, or a certificate of having passed some public qualifying examination, such, for example, as the Oxford or Cambridge Local, the College of Perceptors, the Matriculation for Entrance to a British University, or other equivalent examination. The subjects of the entrance examination are—English, including Geography and History, Mathematics, Freehand Drawing, and three of the following, one of which must be a language:—French, German, Latin, Chemistry, Physics, Mechanics. Another condition of admission is that the students adhere strictly to the school-hours.

For each Department the fees are £15 15s. for each complete session, payable in advance. Students only taking special courses are charged:—For each lecture, workshop or drawing course, 6d. per hour; and for each laboratory course, 1s. per hour; but in no case are students admitted for a less period than half the session. A deposit of £1 1s. is required of each student for breakages, the balance remaining, if there be any, is returned one month after the close of the session.

The Day Courses in the Manchester School of Technology are of three years' duration (the preparatory course, however, being very short), and are the following, viz.:—

(1) Preparatory Course; (2) Mechanical Engineering; (3) Electrical Engineering and Technical Physics; (4) Sanitary Engineering; (5) Bleaching, Dyeing, and Printing, Brewing, Paper-making, and Metallurgy, and Technical Chemistry; (6) Photographic and Printing Crafts; (7) The Manufacture of Textiles and (8) Architecture, Preparatory course, and course for the Intermediate Examinations of the R.I.B.A. The Diploma of the School is awarded to students in each Department after a satisfactory completion of the three years' course. The various courses will be referred to.

35. *The Preparatory Course, Manchester School of Technology.*—The preparatory course is designed for the special benefit of those students who prove by the results of the entrance examination that they have not sufficient preparation in their studies to enter the Technical Departments of the School. Only those students, however, who shew promise that one session's preparation will render them efficient, can be admitted. The subjects taught are English, German, Mathematics, Geography, Chemistry, Wood-work, Mechanics, lectures and Laboratory Practice, Geometry, Freehand Drawing and Physics including lectures and laboratory practice.

36. *Course in Mechanical Engineering, Manchester.*—The instruction given in this course is practical, theoretical, and experimental, but it is intended to be specially strong on the experimental side; and consequently large laboratories are provided, equipped with plant of large capacity, entirely for experimental work. The following is the course of study:—

Curriculum of Course.

Subjects.	Hours per Week.
First Year.	
Mathematics	6
Drawing and Geometry	7
Mechanics, including Laboratory	3
Physics, including Laboratory	6
Chemistry, including Laboratory	6
Workshop Exercises	3
German	2
English	2
Total	35

Subjects.	Hours per Week. Term 1.	Term 2.
Second Year.		
Mathematics	4	4
Drawing	5	3
Mechanics, including Laboratory	3	...
Theory of Mechanics	2	1
Theory of Structures	1	1
Theory of Heat Engines	...	2
Properties of Materials	2	...
Machine Design	1	...
Engineering Workshop	3	3
Machine Testing Laboratory	...	3
Graphics and Machine Testing	2	...
Heat Engine Laboratory and Materials Testing Laboratory	...	5
Smiths' Work	3	3
Moulding	2	...
Electrical Engineering, including Laboratory	1	5
Physics, including Laboratory	3	1
Chemistry, including Laboratory	1	3
German	2	2
Totals	35	35
Third Year.		
Mathematics	1	...
Machine Design	6	7
Theory of Machines	2	...
Theory of Heat Engines	2	1
Hydraulics, including Laboratory	4	3
Machine Testing Laboratory	3	3
Heat Engine Laboratory	5	11
Tool-room	2	4
Engineering Physics Laboratory	...	3
Specifications	1	...
Electrical Engineering, including Laboratory	5	...
Physics Laboratory	3	...
Metallurgy, including Laboratory	1	3
Totals	35	35

37. *Electrical Engineering and Technical Physics, Manchester.*—The course of instruction in Electrical Engineering affords a carefully-graduated training, and students are familiarised with methods of accurate measurement and observation, and instruction is given with a view to imparting a sound knowledge of the laws upon which the various engineering and industrial operations are based. The lectures are accompanied by tutorial classes and by experimental instruction in laboratories for mechanics, physics,

physics, electrical engineering, mechanical engineering, and chemistry. Systematic instruction is also provided in the workshops in the use of wood and metal working tools. The following programme will give an indication of the details of study :—

Curriculum of the Course in Electrical Engineering and Technical Physics.

The first year is identical with that of Mechanical Engineering.

Subjects.	Hours per Week.			
	Year II.		Year III.	
	Term 1.	Term 2.	Term 1.	Term 2.
Mathematics...	4	4	2	2
German	2	2	......	......
Physics	1	1	......	......
Electrical Engineering	2	2	2	2
Electrical Laboratory	5	12	10	10
Alternate Currents ...	1	1	......	......
Electrical Design	......	3	6	7
Theory of Machines...	2	1	......	......
Theory of Heat Engines	......	2	2	1
Theory of Structures	1	......	......	......
Properties of Materials	2	......	......	......
Mechanics	1	......	......	......
Mechanical Drawing	5	......	......	......
Engineering Workshop	2	2	......	......
Graphics and Machine Testing	2	......	......	......
Heat Engine Laboratory ...	......	2	3	4
Materials Testing Laboratory	2	......	......	......
Moulding	2	......	......	......
Chemistry, including Laboratory ...	1	3	......	......
Electrical Calculations	......	......	2	......
Electrical Specifications	......	......	3	3
Hydraulics ...	......	......	2	......
Hydraulics Laboratory	......	......	......	3
Mechanical Engineering Laboratory	......	......	3	3

38. *Equipment for Instruction in Electrical Engineering and Technical Physics, Manchester.*—For this instruction there are two lecture rooms, four laboratories for work in physics and electrotechnics, a research laboratory, two dynamo and motor testing rooms, a standardising laboratory, a high-tension room; electro-chemical, photometric, and optical laboratories; instrument testing, cable testing, and experimental accumulator rooms. The laboratory and testing-rooms are equipped with the modern English, American, and Continental plant and appliances.

The electrical plant includes four 100-kilowatt steam dynamos of different types and a 50-kilowatt turbo-dynamo by Parsons. Three 50-kilowatt experimental machines, by Schuckert, coupled together. A 30-kilowatt three-phase generator, of the rotating field type. A 10-ton electric tram car, body complete with motors, controllers, etc., mounted on friction wheels for experimental purposes. Two single-phase inductor alternators, of 15-kilowatt, driven by two 220-volt continuous current motors. A 15-kilowatt three-phase generator, coupled direct to a 400-volt c.c. motor. Two 5-kilowatt rotary converter sets, with transformers, switchboard, etc. A triple continuous current set of 15-kilowatt, fitted with slip rings, and specially designed for experimental work. A 10-kilowatt Edison-Hopkinson c.c. dynamo, coupled to a 10-horse power steel-clad motor, and a motor generator giving 100 ampères at 20 volts. Five sets of experimental accumulators, with a maximum discharge rate of 4,000 ampères. The laboratories are all supplied with continuous, alternating, and three-phase currents at various tensions, and contain examples of all the most modern forms of electrometers, galvanometers, potentiometers, wattmeters, voltmeters, ohmmeters, and other testing instruments.

39. *Course in Municipal and Sanitary Engineering.*—This course is specially designed for those who intend to become municipal, sanitary, or civil engineers, architects, builders, clerks of works, sanitary inspectors, or factory inspectors; and also for those students who, being already engaged in qualifying for any of the foregoing professions or trades, desire a special knowledge of sanitary engineering in all or any of its various branches, or of the principles and practice of plumbers' work. The courses consist of instruction in:—(*a*) The scientific principles upon which good work is based. (*b*) The practical application of these principles. (*c*) Drawing and the preparation of specifications and quantities. (*d*) Practical surveying

surveying and levelling. (*e*) Visits to works (finished and in course of construction). A more detailed conception of the course will be gained by referring to the following programme of work for the three years:—

CURRICULUM OF COURSE IN MUNICIPAL AND SANITARY ENGINEERING.

The subjects for the first year are identical with those of the two preceding courses.

Subjects.	Hours per Week.			
	Year II.		Year III.	
	Term 1.	Term 2.	Term 1.	Term 2.
Mathematics ...	4	4	1	1
German	2	2	......	......
Sanitary Engineering	2	2	2	2
Building Construction	1	1	1	1
Drawing and Preparation of Specifications	3	4	4	3
Building Construction Drawing	2	......	3	3
Surveying and Levelling	3	3	4	4
Plumbing Workshop	5	6	......	......
Mechanics, including Laboratory Work	3	......	......	......
Graphics	2	......	......	......
Theory of Structures	1	......	......	......
Properties of Materials	2	......	......	......
Hydraulics	......	1	2	......
Hydraulics Laboratory	......	3	2	3
Materials Testing Laboratory	......	3	......	......
Physics	1	1	......	......
Electrical Engineering	1	1	......	......
Chemistry, including Laboratory Work	3	4	5	5
Sanitary Engineering Workshop	......	......	11	13

40. *Equipment for Instruction in Municipal and Sanitary Engineering.*—The equipment for this instruction consists of a commodious drawing-office and lecture-room, well equipped with modern appliances, and a well-arranged workshop, containing benches for 132 students. Each bench is fitted with gas furnaces, oxy-hydrogen and apparatus, and all tools necessary for carrying out the practical work of the department. A portion of the workshop is set apart for appliances used in connection with house drainage, and provision is made for laying and testing the efficiency of drains, traps, and flush tanks of various kinds used for drainage purposes. The extensive drainage arrangements of the school form a part of the equipment of this section, and can be used for demonstration purposes, and for experiments relating to the ventilation and discharging capacity of drains. Examples of waste and other pipes used for domestic purposes are arranged for the use of the student so as to illustrate the most modern practice.

For the purpose of instruction in sewerage work, arrangements are made by which students can lay short lengths of sewers of various shaped sections and of different materials, and to exhibit the use of suitable timber supports for the sides of the trenches in various kinds of ground. Appliances for raising sewage from low to high levels are fixed and at work. The arrangements used for flushing sewers, and other details of construction, are shewn by special apparatus in working order, by models, and by drawings.

The methods of collection and storage of water are illustrated by plans, sections, diagrams, and models of works constructed for water supply, and a large number of water-meters by different makers are fixed and arranged so that a student may thoroughly understand the principles upon which they are constructed, and test their efficiency.

Appliances are provided for practical dealing with the ventilation and heating of buildings.

Examples are shewn of the most approved methods of supplying hot water for domestic and other purposes.

There is a large collection of material used in the making of roads and streets, and special facilities provided for examining and testing the character and properties of materials best suited for certain work.

41. *Course in Chemistry and Chemical Technology, Municipal School, Manchester.*—This Department is divided into five sections, viz.: (1) General Technical Chemistry; (2) Metallurgy; (3) Paper manufacture; (4) Dyeing; and (5) Brewing. The aim of each separate course is to train the student in the purely scientific parts of his subject, and then to teach him, by experiment, how scientific principles may be applied to the operations, and in the development of industrial chemistry. The courses are of three years' duration, and the work of the second and third years (*i.e.*, of the special instruction) is outlined. The details are as follow:—

COURSES OF STUDY IN GENERAL CHEMISTRY.

Subjects.	Hours per week.		Subjects.	Hours per week.	
	Year II.	Year III.		Year II.	Year III.
Inorganic Chemistry	2	...	Mechanical Drawing	2	...
Organic Chemistry	2	2	Mechanical Engineering	2	...
Metallurgy	2	...	Engineering Laboratory	2	...
Chemical Laboratory	16	28	German	2	...
Physical Chemistry	1	...	General Chemistry	...	1
Physics	1	...	Alkali manufacture	...	1
Physical Laboratory	3	...	Chemical Engineering and Plant	...	1

COURSE

COURSE IN METALLURGY.

Subjects.	Hours per Week.		
	Year II.	Year III.	
		Term 1.	Term 2.
Metallurgy ...	2	3	3
Mineralogy and Geology ...	2	2	2
Practical Metallurgy ...	10	9	9
Inorganic Chemistry ...	2	...	...
Chemical Laboratory ...	6	3	3
Physical Chemistry ...	1	...	...
Physics ...	1	...	...
Physical Laboratory ...	3	...	...
Mechanical Drawing ...	2	...	...
Mechanical Engineering ...	2	...	...
Engineering Laboratory ...	2	...	...
German ...	2	2	2
Practical Mineralogy ...	...	2	2
Properties of Materials ...	...	2	...
Materials Testing Laboratory ...	...	4	...
Electrical Engineering ...	...	1	1
Electric Furnace Work ...	...	...	3
Workshop ...	...	3	6
Surveying ...	...	3	3
Chemical Engineering and Plant ...	...	1	1

COURSE IN PAPER MANUFACTURE.

Subjects.	Hours per Week.	
	Year II.	Year III.
Paper Manufacture ...	4	13
Dyeing ...	6	...
Natural and Artificial Colouring Matters...	...	2
Inorganic Chemistry ...	2	...
Alkali Manufacture ...	...	1
Organic Chemistry ...	2	2
Chemical Engineering and Plant ...	...	1
Chemical Laboratory ...	8	12
" " (1st Term) ...	...	12
Physical Chemistry ...	1	...
Physics ...	1	...
Physical Laboratory ...	3	...
Mechanical Drawing ...	2	...
Mechanical Engineering ...	2	...
Engineering Laboratory ...	2	...
Building Construction (2nd Term) ...	...	2
German ...	2	2

COURSE IN DYEING.

The following are the details:—

Subjects.	Hours per Week.	
	Year II.	Year III.
Dyeing ...	2	...
Dyeing Machinery ...	2	...
Dyeing Laboratory ...	8	...
Inorganic Chemistry ...	2	...
Organic Chemistry ...	2	2
Chemical Laboratory ...	6	12
Physical Chemistry ...	1	...
Physics ...	1	...
Physical Laboratory...	3	...
Mechanical Drawing ...	2	...
Mechanical Engineering ...	2	...
Engineering Laboratory ...	2	...
Dyehouse ...	...	13
Natural and Artificial Colouring Matters...	...	2
Chemical Engineering and Plant ...	...	1
Alkali Manufacture ...	...	1
Spinning and Weaving (1st Term) ...	...	2
Building Construction (2nd Term) ...	...	2
German ...	2	2

COURSE

COURSE IN BREWING.

Subjects.	Hours per Week.	
	Year II.	Year III.
Brewing Lecture	2	2
Brewing Laboratory or Brewhouse	8	10
Inorganic Chemistry	2	...
Organic Chemistry	2	2
Chemical Laboratory	8	17
Physical Chemistry	1	...
Alkali Manufacture	1	1
Chemical Engineering and Plant	...	1
Physics	1	...
Physical Laboratory	3	...
Mechanical Drawing	2	...
Mechanical Engineering	2	...
Engineering Laboratory	2	...
German	2	2

42. *Laboratories of the Chemical Department.*—The laboratories of the chemical department are supplied with water, gas, electric power, steam, hydrogen sulphide, vacuum and compressed air, and are fitted with drying ovens, sand-baths, evaporating cupboards, and distilled water plant operated by steam from the main boilers. The main inorganic laboratory has an area of 3,900 square feet, and is ventilated by a rotatory air propeller; it has bench accommodation for eighty students. The chief organic laboratory accommodates sixty-four students, and, in addition to the fittings mentioned above, it contains a large model Fluess pump worked mechanically and provided with drying apparatus cooled by liquid air, for use in distillation under very low atmospheric pressures. It is also provided with mechanical shaking, stirring, and grinding apparatus, centrifuges, etc., worked by electric power. An Auxiliary laboratory has been fitted up for organic work of special kinds, and on the roof has been erected a commodious laboratory in which chemical operations giving rise to disagreeable fumes can be conveniently performed. The combustion room is fitted with combustion and Carius furnaces used in organic analysis, and also contains a number of autoclaves of various patterns and sizes. The physical chemistry laboratory has an area of 1,230 square feet, and is equipped with constant temperature baths, apparatus for molecular weight and electrical conductivity determinations, spectroscopes, spectrometers, polarimeters, goniometers, refractometers, calorimeters, and calorimetric bomb, etc., and with a bench supplied with current for electro-chemical work. The apparatus used in the analysis of gases is fitted with automatic mercury pumps and with a mercury distillation apparatus. A water analysis laboratory has been provided in order to avoid the difficulties inherent to the carrying out of water analysis in a general chemical laboratory.

The elementary and advanced metallurgical laboratories are fitted with wind and muffle furnaces worked by gas and coke and with Carr furnaces, etc., and will accommodate fifty students.

There is a building for practical instruction in bleaching, dyeing, printing, and finishing textiles, and for paper-making. It has a testing laboratory for paper, a lecture room, a dark room, and a micro-photographic laboratory. This building, which is heated and ventilated on the most approved methods, is equipped with machines of special design and construction, with a view to experimental operations and research on an industrial scale in connection with the bleaching, dyeing, printing, and finishing of textiles, and with the manufacture, dyeing, and finishing of paper, and so arranged as to allow of investigation into, and comparison between the various processes employed.

The dyeing laboratory accommodates thirty students; it is fitted with experimental dye-baths colour pans, and drying cupboards heated by steam, hand printing machines, matching lamps, etc. With it is connected a pattern room and a laboratory for the analytical and other general chemical work relating to dyeing.

The brewing laboratory is fitted with benches for analytical and preparation work, microscope tables, incubators, etc., and is provided with a brewing instrument room in which are found saccharimeters, sterilisers, calorimeters, etc.

For paper manufacture there is a fully equipped paper-making plant, comprising a specially designed and built Fourdrinier paper-making machine for paper 24 inches wide. The plant includes:—Ragboiler, breaker, beater, stuff-chest, sandtables, strainer, the wire with suction boxes, dandy roll and couch press; wet presses, drying cylinders, slitter knives, winding apparatus, length and cross cutter, calenders, re-winding apparatus.

3. *Courses in Photography and Printing, Municipal School of Technology, Manchester.*—The studies of this course are so arranged as to impart a general yet sound knowledge of the principles of science, and to shew their application to the special branch of the printing and photographic industry. The studies of the student depend upon the particular sphere of work to which he ultimately intends to devote himself. The following is the course of instruction :—

CURRICULUM OF COURSE IN PHOTOGRAPHY AND PRINTING.

First Year.

Subject.	Hours per Week.
Drawing...	3
Mathematics	4
German	2
Applied Mechanics	3
Physics	3
Chemistry (including Laboratory)	5
Photography, Pure (including practical work)	6
Photo-Mechanical Processes (including practical work)	4
Typography—Composing Room	3
„ Machine and Press Room	2
Total	35

Second Year.

Subjects.	Hours per Week.		
	Printers.	Photo-graphers.	Photo Engravers.
Drawing	......	2	2
Chemistry (including Laboratory)	......	5	5
German	2	2	2
English	2	......	......
Mechanical Engineering (including Laboratory) ...	4	......	......
Typography—Composing Room (including lectures)	10	......	......
,, Machine Room (including lectures) ...	11	......	5
Photography—Lectures	......	2	2
,, Practice	......	15	5
Photographic Optics	.. ...	2	2
Photo-Mechanical Processes—Lectures	1	1	1
„ „ Practice	6	6	11

Third Year.

This year the courses are arranged with a view to more specialised work.

Subjects.	Hours per Week.		
	Printers.	Photo-graphers.	Photo-Engravers.
Physics	...	2	2
Electrical work...	2	2	2
Chemistry	...	2	2
German	2	2	2
Electrotyping and Stereotyping Lectures	2	...	2
Typography—Composing	12	...	...
,, Machine and Press Work	12	...	4
Photography—Lectures	...	2	1
„ Practice	...	18	3
„ Photo-Mechanical Processes... ...	...	...	...
„ Lectures	2	2	2
„ Practice	3	5	15
	35	35	35

The courses of the first year are general rather than special, whilst in the second and third years they are chiefly restricted to the requirements of the particular business in which the student will be engaged.

44. *Equipment for Photography and Printing.*—The equipment embraces Letterpress, Composing, and Machine Rooms, Lithographic Printing Room, Etching Room, Electrotyping Room, Photographic Studio and Dark Rooms, Laboratory, Lithographic Drawing and Design Studio, and Bindery. Each has a complete equipment of special appliances and machinery for the effective practical treatment of the subject taught.

45. *Course in Textile Industries, Municipal School of Technology, Manchester.*—These courses are designed to impart a knowledge of the theory and practice of spinning and weaving which will be of special value to those who are, or who intend to be, engaged in the spinning of yarns; the designing for, and the manufacture of, woven fabrics; the buying and selling of yarns and fabrics, and the manufacture or export of textile machinery. The course of instruction is as follows:—

CURRICULUM OF COURSE IN TEXTILE INDUSTRIES.

Subjects.	Hours per Week, First Year.
Mathematics	4
English	2
Practical Spinning	2
Practical Weaving	2
Design and Analysis	4
Fabric Structure	2
Colour	1
Freehand Drawing	2
Geometry	4
Mechanics, including Laboratory	3
Physics, including Laboratory	6
Chemistry	3
Total	35

Subjects.	Hours per Week. Year II. Term 1.	Year II. Term 2.	Year III. Term 1.	Year III. Term 2.
Mathematics	2	2	...	...
Spinning	1	1	2	2
Practical Spinning	4	4	4	5
Spinning Calculations	1	1	1	1
Fabric Structure	1	1	1	1
Practical Weaving	4	1	4	6
Weaving Calculations	2	2	...	...
Weaving Mechanism	1	1	1	1
Textile Testing Laboratory...	2	2	2	2
Design and Analysis	4	4	2	2
Applied Design	...	...	2	2
Textile Ornament and Colour	1	1	...	...
Design and Ornament	...	...	2	2
Drawing for Design and Ornament	2	2	...	...
Drawing	...	...	2	2
Mechanics	1	...	...	...
Mechanical Engineering	2	2	...	...
Engineering Laboratory	2	2	...	...
Machine Drawing	2	2	...	...
Textile Chemistry	3	3	3	3
Theory of Machines...	...	...	2	1
Machine Testing Laboratory	...	...	2	...
Electrical Engineering	...	...	2	2
Electrical Laboratory	...	...	2	2
Totals	35	31	34	34

46. *Equipment for Instruction in the Textile Industries.*—The completeness of the equipment in this department of the school may be realised by a study of the following statement:—

For *Cotton Spinning* the equipment consists of the following machines, viz.:—Typical cotton gins, 4; roller, and hopper bale breakers, mixing lattices, and cotton bins, 2; willow, compound opener, with hopper feed and lap-attachment, single scutcher, 3; revolving flat, roller and clearer and condensing cards, 4; silver lap, ribbon lap, and combers, 4; drawing frame, 4; slubber, intermediate, rover, and

 jack

jack frames, 4; waste, medium, and fine mules, and mule headstock, 4; twist and weft ring frames, 2; doubling winder, ring doubler, and twiner, 3; clearing, gassing, reeling, preparing, and bundling, 5; roller covering plant, 10; flat, roller and cylinder, stripping, grinding, and burnishing machinery; mill plans, and arrangements of machinery; specimens of coarse, medium, and fine, grey, and coloured cotton in various stages of preparation.

The *General Equipment of the Preparation Department* is as follows:—Winding Machines for warp and weft; mill, beam and sectional warping machines; Yorkshire dressing frames; running-off frame for sectional warping; drawing-in and twisting frames; piano card-cutting machine; dobby card-punching frame; and lacing frame.

The *General Equipment of the Weaving Shed*, consists of hand-looms and power-looms. The hand-looms are: 1 treadle loom; 11 dobby looms; 12 jacquard looms and 1 pattern loom, making in all, 25. The power looms are as follows:—12 tappet looms, 9 being single-box and 3 multiple boxes; 9 dobby looms, 4 being single-box and 5 multiple boxes; 10 jacquard looms, 3 single-box and 7 multiple boxes; 1 lappet; 2 terry; 1 plush; and 2 automatic—making in all, 37.

The *equipment for silk-spinning and preparation* is the following:—2 cocoon reeling; 5 hard silk-winding, cleaning, doubling, spinning, and throwing-machines; 1 hard silk-reeling; 3 soft silk-winding, re-drawing, pirn-winding; 2 mill and sectional warping; 1 winding-on; 1 reel steaming chest; 1 reel stand; 2 drumming and deniering scales; 2 splitting rices; 1 boiling pan; 1 steeping tub, and 1 soap cutter.

The equipment for silk-weaving are hand looms and power looms—the former consisting of 2 treadle, 7 jacquard, and 1 ribbon; the latter of 1 tappet, single-box; 1 dobby, single-box; 1 dobby, multiple boxes; 6 jacquard, viz.—2 single-box, 3 multiple boxes, and 1 swivel.

The *equipment of textile testing laboratory* is as follows, viz.:—3 wrap reels; 18 scales and balances; 3 microscopes; 2 lea testers; 3 single-thread testers; 2 cloth testers; 3 water bath ovens; 3 conditioning stoves; 3 twist testers, and 3 hygrometers.

47. *Special Classes, Municipal School of Technology, Manchester.*—The special classes offer (*a*) courses of instruction in architecture, building construction, and modern practice; and (*b*) manual training for schoolmasters, teachers, and others, in the use of wood-working and metal-working tools.

The former (*a*) are intended expressly for architects' pupils, improvers, and assistants desirous of presenting themselves for the Intermediate Examinations of the Royal Institute of British Architects, so as to qualify for the grade of Student of the Institute, and in preparation for the final grade of Associate. There are three courses in all, each the duration of one term, and the fee charged is £3 3s. The following is an outline of the courses:—

Course I. Plane and Solid Geometry.—Plane geometry applied to actual work; definition of terms; projection and interpenetration of solids; isometrical projection; development of surfaces.

Course II. Building Construction.—Nature, qualities, and defects of ordinary building materials; calculation of strength of materials and resistance; elementary principles of construction; details of construction.

Course III. Architecture.—The orders of Greek and Roman architecture, their origin, development, and application; the several varieties of Classic ornament; the characteristic mouldings and ornaments of each period of English architecture, from A.D. 1000 to A.D. 1550; outlines of Mediæval and Renaissance architecture in Europe.

The *Manual Training Class* (*b*) has two divisions, viz., one for instruction in wood-work, and the other for instruction in metal-work. The object aimed at in the division for wood-work is to give masters and teachers of public elementary and secondary schools, and also other persons who have passed in the Ordinary Grade at least in one of the following subjects: carpentry and joinery, ship-carpentry and joinery, cabinet-making, carriage-building (road or rail), wheelwrights' work, and van and cart building—a practical knowledge of the use of wood-working tools, of geometrical drawing, isometric projection, and of drawing to scale as applied to wood-working, with the more especial object of enabling them to introduce manual training into elementary secondary schools.

The course consists of about thirty-four lessons of two and a-half hours each, is carefully graduated, and includes instruction in the nature, use, and object of the tools and materials employed, and the best methods of preparing drawings and laying out the work, and in the application of descriptive geometry to wood-working.

Opportunity is given for discussions on the methods, aims, and educational bearing of the course of instruction. This course of instruction and workshop practice prepares candidates for the examination held by the City and Guilds of London Institute. The fee for the course is 15s., including the use of *tools and materials*, and also the examination fee, 5s.

The course in *metal-work* is of two years' duration, and is exclusively for those schoolmasters or teachers who have completed and passed the first year examination of the City and Guilds of London Institute in manual training for wood-work.

The course for the first year consists chiefly of practical exercises in metal-work, including vice, bench, and forge work, together with drawing in connection therewith.

The course for the second year comprises exercises in the workshop similar to, but more advanced than those of the first year—bench work, which includes brazing; exercises requiring the use of the lathe, including chasing, and the use of the slide rest, and in methods of screw-cutting. This course is exclusively for students who have passed the examination for the first year.

Instruction is given in making freehand dimensioned sketches, plan and elevation, of hand and machine tools and other workshop fittings, and of exercises for practical work, as well as in making working drawings to scale. The forms and angles of cutting edges of tools as used for vice and bench work, and for lathes and drilling machines, are explained, together with the construction and use of these machines; the principle of working of gas and steam engines; arrangement of the fittings; pulleys and belting; and the fitting and equipment of a school workshop, and arrangement of lessons, etc.

Certificates are granted on the result of each examination, but the Teacher's Certificate is given only to those candidates who pass the final examination.

48. *Day Classes for Women, Manchester.*—These classes were formed for the purpose of giving instruction in theoretical and practical dressmaking, plain and art needlework and millinery. For theoretical and practical dressmaking, there are five courses, viz.:—Elementary course, advanced course in dressmaking, course in costume making (ladies' tailoring), design course, and course in stock cutting. There is also a workroom class.

The *Elementary course* is arranged to meet the needs of those who desire to learn the elements of dressmaking. It comprises systems of cutting and fitting bodices and skirts by measurement, and the practical making-up, finishing, and fitting of walking skirts, bodices, lined and unlined shirt-blouses, transparent slips, and slip-bodices. Manufactured aids are resorted to for rapid inside finishing, and special attention is given to the carrying out of the styles and trimmings in vogue. The aim of the instruction is to impart to students facility in copying fashion-plate designs, to the end of enabling them to follow variations of fashion, and of giving them skill and readiness in cutting, fitting, trying-on, and making alteration, in respect of fit and style.

Students who take this course may present themselves for the examination in dressmaking, held by the Lancashire and Cheshire Union of Institutes.

The *advanced course in Dressmaking.*—The course of instruction during the first term comprises advanced cutting and fitting, and the drafting, cutting-out, and making-up of garments other than the standard close-fitting dress (as Norfolks, coatees, zouaves, boleros, evening bodices and trained skirts, dressing gowns, princess robes, cycling skirts and knickers, and children's robes and smocks, etc.), with the differences in making-up and finishing required by the differences of style. The course also aims to give students increased facility in copying fashion-plates, and in following new designs, by lessons on the placing of style lines on plain draftings, and the making-up in practice material of sketch-models, with special attention to the correct reproduction of the distinctive features of the prevailing fashions in such accessories as fancy collars, sleeves, vests, belts, boleros, etc. It is optional for students who have already taken the elementary course to enter for the advanced course, or to take the certificate course of the City and Guilds of London Institute.

Course in Costume-making (Ladies' Tailoring).—This course covers cutting-out by measurement on tailor lines and principles, and making-up by high-class tailor methods of coat-and-skirt costumes for ladies and girls, and of unlined (thick) winter jackets and capes, with special attention to the fine finish which distinguishes tailor-work. Students must understand one (any) system of bodice drafting, and should have some experience in dressmaking, or in the management and manipulation of thick textiles.

Design Course.—The aim of this course is to make clear the principles that underlie all systems of drafting, directing attention to the outline and proportions of the female figure, and the lines required to clothe it harmoniously—the poise of the body, and its requirements in balance, and the construction of the pattern. Various French and English lines of pattern-construction are shewn and explained, and the production of the pattern by moulding on the figure practically demonstrated.

The course also includes the general principles of style-cutting, by which pattern modellers are enabled to cut so as to follow designs and fashions and the adaptation of the plain bodice or skirt pattern to variations of style—the form of trimmings or sections of garments on the flat, and their finished effect in the made-up garment—the hang of the thread in the different ways of the material, and the width-bases and their limitations in seam-placing—the suitability of design to the various types of figure, the position of curve and line in the placing of seams—the disposal of trimming or other decorative lines, and the modifications which adapt them to the individual.

Students must thoroughly understand one (any) system of drafting, and the cutting of plain gored skirts.

Courses in Stock-cutting.—These courses cover the cutting of garments (dresses, mantles, underclothing, childrens' garments) to correct size and shape, the increasing or decreasing ranges of sizes in due proportion, the economy of material in quantities, instruction in cutting to several graded sizes from any copy or illustration, and facility in designing. Students are provided with a stock of varied and suitable shapes and designs.

Workroom Class.—The instruction received in this class is designed to supplement the courses in elementary dressmaking, by giving the students the opportunity of producing practical work under the teacher's supervision. Students may make up one or more dresses or other garments, either for themselves or other persons in this class; they must provide their own materials.

There is a Certificate in Dressmaking awarded by the City and Guilds of London Institute.

Private lessons may be taken.

49. *Plain and Art Needlework, Manchester.*—For this branch of industry there are three courses, viz., (1) Plain and fancy household needlework, (2) Certificate course for teachers in plain needlework, and (3) Embroidery and art needlework. To each course a session of two terms is devoted, a fee of 15s. per term for each being charged.

Plain and Fancy Household Needlework.—This course comprises all branches of plain and fancy needlework used in the household, plain sewing, mending and patching, with darning for stockings and woollen garments, crotchet work and knitting, netting, tatting, and drawn linen, and the usual fancy stitches for underclothing, including smocking, drawn linen, and hem-stitching, and the cutting out and making-up of a set of garments. Students are required to make samplers, and three or more articles embodying the instruction given during the course.

Certificate Course for Teachers in Plain Needlework.—This consists of a special preparation course for students desirous of obtaining the Certificate of the City and Guilds of London Institute. The details of instruction comprise:—The points to be observed in cutting-out calico and flannel, the most suitable materials to be used for different under-garments, the different systems of cutting-out, the various stitches used in plain needlework, the methods of patching and darning.

50. *Embroidery and Art Needlework.*—This course includes art needlework in all its branches, with all the stitches and their application to leaves and foliage, conventional ornament, light and shade, grouping and colouring.

Millinery.—There are two courses for instruction in millinery, one an elementary and the other a certificate course. The courses are of two terms' duration, 15s. per term being charged for each.

Elementary

Elementary Course.—This course is arranged to meet the requirements of the beginner, and of the student anxious to master the subject from its commencement; it includes all the details of lining, trimming, facing brims, and making up hats, dress caps, bonnets, and toques; the making of hats, caps, and bonnets for infants and children; instruction in making bows and other fashionable trimmings; the handling of delicate and transparent fabrics, and the management of lace, straw, etc. Becomingness in form, colour, and the making of simple shapes in foundation materials are also included in this course, in addition to the making of fancy muffs, neck ruffles and collars, fichus, etc.

Certificate Course in Millinery.—The instruction given in this course is so arranged as to meet the requirements of the examinations held by the City and Guilds of London Institute, their certificate being awarded in cases of success.

There are also special training courses for teachers in all these departments of work.

51. *Evening Classes, Municipal School, Manchester.*—The evening classes have sections for (I) Commerce; (II) Science; (III) Technology; and (IV) Art. Students are admitted on the express condition that they make the required attendances, and sit for such examinations as may be arranged. No student may enter any class without having first procured a ticket, which must be shewn to and initialled by the teacher. Students may compete for Whitworth Scholarships or Exhibitions or for Royal Exhibitions and National Scholarships.

Commerce (Section I).—The following is a list of the subjects of instruction taught in this connection, and to which very thorough development is given:—

Accountancy, arithmetic, book-keeping, business training, commercial English, commercial geography and history, commercial and industrial history, commercial law, handwriting, shorthand, type-writing, Danish, French, German, Modern Greek, Italian, Latin, Portuguese, Russian, Spanish, ambulance work, citizenship, elocution, English literature, political and social economy.

The courses comprise carefully-graded lessons and lectures for accountants, book-keepers, secretaries, correspondents, travellers, and agents; for bankers', insurance, solicitors', and shippers' clerks.

52. *Science and Technology (Sections* II *and* III), *Manchester.*—The subjects included under this heading are (1) pure, practical, and applied mathematics; (2) mechanical engineering; (3) physics and electrical engineering; (4) architecture and builders' work, municipal and sanitary engineering; (5) the building trade; (6) pure and applied chemistry; (7) textile industries; (8) the photographic and printing trades; (9) dressmaking, millinery, and plain needlework; (10) natural science.

There are five year courses leading to the diploma of the school with the title of associate and three year courses leading to a certificate of competency, as follows:—

Diploma Courses.

I. *Mechanical Engineering.*

Year I—Mathematics, geometry, machine drawing.
" II—Mathematics, mechanics and steam, machine drawing.
" III—Mathematics, mechanics and steam, mechanics and steam laboratory.
" IV—Mixed mathematics, strength of materials, theory of heat engines, materials testing and heat engine laboratories.
" V—Hydraulics, hydraulic laboratory, theory of machines, machine-testing laboratory, steam-engine laboratory, gas-engine laboratory, refrigerators.

II. *Electrical Engineering.*

Year I—Mathematics, magnetism and electricity (lecture and laboratory), machine drawing.
" II—Mathematics, electrical engineering (lecture and laboratory), mechanics and steam.
" III—Mathematics, electrical engineering, mechanics and steam, electrical laboratory.
" IV—Electrical engineering, electrical design, electrical laboratory.
" V—Alternating and polyphase currents, electrical design or steam-engine laboratory, electrical laboratory.

III. *General Physics.*

Year I—Mathematics, mechanics, physics (lecture and laboratory).
" II—Mathematics, physics (lecture and laboratory), chemistry (lecture and laboratory).
" III—Mixed mathematics, physics (lecture and laboratory), chemistry (lecture and laboratory).
" IV—Mixed mathematics and mechanics, physics (lecture and laboratory), chemistry (lecture and laboratory).
" V—Mathematics, physics (lecture and laboratory), physics (laboratory).

IV. *Electro-Chemistry.*

Year I—Mathematics, physics, inorganic chemistry.
" II—Mathematics, general physics, inorganic chemistry.
" III—Electrical engineering, inorganic chemistry, organic chemistry.
" IV—Chemistry, electro-chemistry, electrical engineering.
" V—Electro-metallurgy, electro-chemistry (two evenings).

V. *General Chemistry.*

Year I—Mathematics, physics (lecture and laboratory), inorganic chemistry (lecture and laboratory).
" II—General physics, organic chemistry, inorganic chemistry (two evenings).
" III—Organic chemistry, inorganic chemistry (two evenings).
" IV—Organic chemistry (two evenings), inorganic chemistry.
" V—Organic and inorganic chemistry laboratory (three evenings).

VI. *Dyeing.*

Year I—Mathematics, physics, inorganic chemistry.
" II—Organic chemistry, inorganic chemistry, machine drawing.
" III—Organic chemistry, technical analysis, engineering lecture and mechanics.
" IV—Dyeing (lecture and laboratory), organic chemistry, engineering laboratory and descriptive engineering.
" V—Dyeing lecture and demonstration, practical dyeing, sanitary engineering and building construction.

VII. *Paper-making.*

Year I—Mathematics, physics, inorganic chemistry.
" II—Organic chemistry, inorganic chemistry, machine drawing.
" III—Organic chemistry, technical analysis, engineering lecture, and mechanics.
" IV—Paper (lecture and laboratory), organic chemistry, engineering laboratory and descriptive engineering.
" V—Paper (lecture and demonstration), practical paper-making, sanitary engineering, and building construction.

VIII. *Brewing.*

Year I—Mathematics, physics, inorganic chemistry.
" II—General physics, organic chemistry, inorganic chemistry.
" III—Organic chemistry, brewing, mechanics.
" IV—Machine drawing, brewing, technical mycology.
" V—Brewing laboratory (three evenings).

IX. *Metallurgy.*

Year I—Mathematics, physics, inorganic chemistry.
" II—Inorganic chemistry, machine drawing, metallurgy.
" III—Mineralogy, metallurgy, mechanics, and steam.
" IV—Mineralogy, metallurgy, engineering laboratory and descriptive engineering.
" V—Mineralogy, metallurgy, applied electricity and electro-metallurgy.

X. *Municipal Engineering.*

Year I—Mathematics, chemistry, physics.
" II—Mathematics, mechanics, chemistry.
" III—Surveying and levelling, graphics, building construction.
" IV—Municipal engineering, building construction, municipal engineering drawing.
" V—Laboratory exercises with municipal engineering appliances, testing materials, hydraulics (lectures and laboratory), drawing and preparation of specifications (municipal engineering).

XI. *Sanitary Engineering.*

Year I—Mathematics, chemistry, physics.
" II—Mathematics, mechanics, chemistry.
" III—Building construction, plumbers' work (theory), sanitary engineering drawing.
" IV—Sanitary engineering, simple surveys and levelling, sanitary engineering drawing.
" V—Laboratory exercises with sanitary engineering appliances, testing materials, hydraulics (lectures and laboratory), drawing and preparation of specifications (sanitary engineering).

CERTIFICATE COURSES.

A. *Electrical Wiremen.*

Year I—Mathematics, magnetism and electricity, geometry.
" II—Wiring lecture and calculations, electrical engineering (lecture and laboratory), wiring (practical work).
" III—Electrical engineering (lecture and calculations), electrical laboratory, practical wiring.

B. *Telegraphists and Telephonists.*

Year I—Mathematics, magnetism and electricity (lecture and laboratory), practical work.
" II—Electrical engineering (lecture), telegraph and telephony (lecture), electrical laboratory.
" III—Telegraphy or telephony, magnetism and electricity (lecture and laboratory), electrical testing.

C. *Electrical Instrument Makers.*

Year I—Mathematics, magnetism and electricity (lecture and laboratory), engineering drawing.
" II—Electrical instruments (lecture and design), mathematics, instrument shop.
" III—Electrical engineering (lecture and laboratory), electrical design, electrical testing.

D. *Plumbing.*

Year I—Mathematics, chemistry, drawing, workshop.
" II—Mathematics, chemistry, mechanics and physics, plumbers' work (lecture and practical), drawing.
" III—Plumbers' work (lecture and practical), drawing.
" IV—Plumbers' work (lecture and practical), drawing.
" V—Testing materials and research into matters relating to plumbers' work, practical plumbers' work, drawing.

E. *Sanitary Inspection.*

Year I—Mathematics, chemistry, physics, hygiene.
" II—Sanitary inspection (lecture), hygiene, drawing.
" III—Laboratory exercises in sanitation, drawing.

F. *Spinning.*

Year I—Cotton and cotton sampling, spinning theory, machine drawing, practical spinning, slide-rule (summer course).
„ II—Spinning, spinning calculations, mechanics, practical spinning.
„ III—Spinning, spinning calculations, steam, practical spinning.

G. *Weaving.*

Year I—Fabric structure, weaving calculations and analysis, weaving mechanism, practical weaving, plane geometry, freehand drawing and colour, machine drawing, slide-rule (summer course).
„ II—Mechanics, design and analysis, design and ornament, weaving, practical weaving.
„ III—Weaving, practical weaving, design and analysis, design ornament.
„ IV—Weaving, practical weaving, applied design, steam.
„ V—Testing yarns and cloth, testing laboratory, applied design, practical weaving.

53. *Full Technological Certificate.*—The candidate for the full Technological Certificate of the City and Guilds of London Institute must have passed in the Honours Grade, and, if not otherwise qualified, will be required to have passed the Board of Education's Examinations in the Advanced Stage in two of the subjects most closely allied to the technological subject he has been studying.
There are elementary, advanced, and honour stages in each subject.

54. *The Municipal School of Art, Manchester.*—"The object of this school is to give, by a system of carefully considered and varied courses of study, with due regard to the bent and capacity of individuals, a thoroughly practical knowledge of designing, drawing, painting, and modelling, more especially in the various forms of their ornamental application in association with architecture and technical conditions of manufacture; so as to furnish not only a useful elementary training to those without previous knowledge of art, but also a helpful system of study sufficiently complete to be valuable to both designers and craftsmen, as well as to those who desire to pursue design in its more strictly graphic and pictorial directions. It is, further, the object of the school to assist those who desire to make a knowledge of art a part of their general education, and also to give facilities for the training of persons who intend to adopt art as a profession, or to include it in their general qualifications as teachers in public elementary or other schools."
Courses of Instruction, Municipal School of Art.—The following are the courses of study:—

Elementary Course.—Instruction is given in freehand and model drawing, geometry and perspective, blackboard drawing and brushwork exercises on natural and ornamental forms; elementry modelling in clay; drawing in outline and light and shade from the cast.

Design.—Studies in elementary design; advanced designs for printed and woven fabrics, embroidery, decorative painting, stained glass, pottery, metal work, and gesso; figure composition and the use of the figure in ornament; drawing and painting of flowers and foliage in water colour and in tempera; lectures upon colour and the technique of design, the principles of ornament, and upon the history of the various historic styles of ornament; the study of fine examples of ancient and modern craftsmanship.

Painting.—Painting in oil and water colour groups of flowers, fruit, and natural objects; painting from the cast and the antique figure; painting from the head and the full length living model; painting from the draped model; lectures upon the technique and history of painting.

Modelling.—Modelling from the cast and from natural flowers and foliage; modelled design; modelling from the antique; modelling the head and the full length living model; modelling the figure for architectural sculptors; lectures upon the proportion and the artistic anatomy of the human figure; lectures upon the technique of design and the history of the various periods of ornament and sculpture.

Figure Drawing, Painting, and Composition.—Elementary and advanced drawing and painting from the antique and the life; figure painting for decorative composition; the study of drapery upon the antique and the life; memory studies and time studies of the figure; composition of figures for pictorial and decorative treatment; lectures upon proportion and the artistic anatomy of the human figure.

Architecture.—Architectural drawing; elementary architecture; architectural design; sketching and measuring from casts of classic and Gothic architecture; architectural sketching and measuring from existing buildings; architectural modelling; the study of the figure and ornament in architecture; the history of architecture; the preparation of the testimonies of study, and of candidates for the examinations of the Royal Institute of British Architects.

Certificates.—The preparation of the necessary drawings, models and designs, and of students for the examinations for the certificates for Teachers and Art Masters granted by the Board of Education; preparation of students for the National Scholarships, Royal Exhibitions, County Council Exhibitions and Scholarships, and for the Royal Academy and the Royal Institution Scholarships.

The school-year consists of forty-two weeks, divided into three terms of about fourteen weeks each. The instruction is given from 9 to 12·30, 1·30 to 4, and 7·25 to 9·30, except in the third term, when the time for evening study is from 7 to 9.
Fees.—The following are the fees charged:—

	£	s.	d.		£	s.	d.	
Every Day	3	0	0	per term, or	7	0	0	for the Session of three terms.
Three Days	2	0	0	„	5	0	0	„ „
Every Half-day	1	10	0	„	3	10	0	„ „
Three Half-days	1	0	0	„	2	10	0	„ „
Every Evening (7·25 to 9·30) ...	0	7	6	„	0	15	0	„ „
Three Evenings (7·25 to 9·30)...	......			„	0	12	6	„ „

The works of students, such as drawings, paintings, and modelled work of an advanced character, are sent to South Kensington to be submitted for examination.
Associated with school is an extensive museum, which comprises three large rooms, known respectively as the Textile Court, the Italian Court, and the Gothic Court, and in addition an East and West Corridor. Each room and corridor is equipped with characteristic objects of artistic skill and handicraft, either original or in fine reproductions. The whole of the collection is at the service of the students, and forms a valuable Library of Applied Art.
There is a library and reading room, which contains many valuable and richly illustrated standard publications on Art, and is available to the students for the purpose of study, and for aid in their practical work.

55.

55. *General Remarks on Technological Instruction in Manchester.*—The extent of the provision for technological instruction in Manchester is remarkable. With the University the whole range is covered, and the equipments are lavish. Instruction of every grade is provided and adapted to pupils of every grade of preparation. The trend of the whole scheme is toward thoroughness of organisation, but it cannot be said to have reached that end yet.

Comparing the highest grades of preparation in England and Germany, one may say that the preparation of the student in the Oberrealshule is more thorough than in English schools of a similar type, hence the work of the Technische Hochschule is more thoroughly and satisfactorily organised than in either the Engineering School, etc , of a University, or an English advanced technical school. Nevertheless so fine an attempt as that made at Manchester to meet the need for good technical education will assuredly be followed, as in fact *is* being followed, by gratifying results in regard both to the industrial power and industrial efficiency of the young people for whom it has been instituted, and as general education advances the technical branches will be more methodically organised.

56. *City and Guilds Central Technical College, Exhibition Road, London.*—The City and Guilds Central Technical College, the chief college of the City and Guilds of London Institute, is an establishment for higher instruction (of a University character) in mechanics and mathematics, civil, mechanical, and electrical engineering, and chemistry. Its chief aim is to "practically demonstrate the application of different branches of science to various manufacturing industries." A Diploma of Associate of the City and Guilds of London Institute is granted to students who have matriculated before entering the College, after a successful pursuance of a three years' course of study. In special cases, and if they testify to sufficient preparation to follow the Course, non-matriculated students are admitted to the first year of the Diploma Course, but they are obliged to pass the Matriculation before entering on the second year, in order to become eligible for the Diploma. An Honours Certificate is awarded to diplomaed students at the end of a fourth year devoted to advanced study and research and on the presentation of an approved thesis on the work done during that year. There are also special or partial courses forming part of each diploma course, for admission to which candidates must prove their ability to follow at least the second year's course, but they are not required to matriculate.

Besides the Diploma of Associate (A.C.G.I.), the Fellowship of the Institute (F.C.G.I.) is conferred by the City and Guilds of London Institute on those who, having obtained the Associateship, and having spent at least five years in actual practice, produce evidence of the execution of original and valuable research work or of the contribution to the advancement of the industry in which they are engaged. A certificate is granted to those who, failing to obtain the Diploma, yet pass the examinations with credit.

The hours of attendance are from 10 a.m. to 5 p.m. on five days a week.

The *Matriculation Examination*, as above stated, forms the entrance examination to the full college course, and is open to candidates who have attained the age of 16 years. The subjects that must be passed are:—Mathematics and mechanics, one language (English, French or German), and any two of the following: mechanical drawing, physics, and chemistry. Four Scholarships are awarded if the results are satisfactory.

57. *Courses of study, City and Guilds Central Technical College.*—The courses are as hereunder:—

(1.) *Course in Mechanics and Mathematics, 1st Year.*—Abridged arithmetic; theory of indices, logarithms and trigonometry, especially with a view to practical applications and numerical calculations; mensuration of areas and volumes, both graphically and by aid of algebra and trigonometry, and by aid of planimeters; theory of vectors, with applications to statics and graphical statics for the determination of stresses in frames; elementary solid geometry; projective geometry with application to descriptive geometry and the theory of conics; introduction to co-ordinate geometry; elementary kinematics and kinetics; mechanical laboratory practice.

2nd Year.—Kinematics of a point, as introductory to the differential and integral calculus with various applications; kinetics; the laws of motion and application to the motion of solids and systems of solids; statics and hydrostatics; co-ordinate geometry of two dimensions; determinants and theory of equations; mechanical laboratory practice and drawing.

3rd Year.—Lectures and exercises for students of the departments of engineering and electrical engineering.

(2) *Course in Civil and Mechanical Engineering.*—The subject for 1st year students are:—Chemistry; physics (lectures and exercises); mathematics, the same as that outlined for the first year in the above-mentioned course; engineering drawing; mechanical laboratory; mathematical exercises; engineering workshop; physical laboratory practice.

For the *2nd year* the subjects are: Engineering workshop; engineering design; chemistry (lectures); electrical technology; engineering lecture and exercises; mathematics (lectures and exercises); mechanical, chemical and technological laboratory practice and photography.

The subjects of the *3rd year* are: Mathematics; engineering (lectures, laboratory, and workshop practice); electrical technology or chemistry; engineering quantities and estimating; engineering design and exercises; valve gear designing and exercises; surveying; field-work. There is also a course in workshop book-keeping and accounts.

The engineering laboratory is furnished with a 100-ton testing machine and a large amount of subsidiary apparatus. Experimental investigations are carried out with a steam-engine constructed for that purpose. The effects of varying the conditions of working on the economy of the engine are studied, and systematic practical investigations of the properties of materials, such as steel, iron, stone, and cement are affected.

(3.) *Course in Electrical Engineering.*—The work done throughout the three years in this course is mainly experimental and original, the lectures being merely subsidiary. The third year work is confined almost entirely to independent research. In the first year the course consists of: Mathematics (lectures and exercises); physics (lectures and exercises); chemistry; engineering drawing; mechanical laboratory; engineering workshop; physical laboratory. In the *2nd year* the students begin to specialise, the time being devoted principally to electrical technology by attendance at the electrical laboratories and

and lectures on the application of the principles of electricity and magnetism to electric engineering, and by working exercises. Attention is also given to mathematics (lectures and exercises) and to engineering design. The third year is mainly devoted to original research, mathematics, and electrical technology (laboratory and workshop practice).

The laboratory course in electrical technology is given in the "four electrical and magnetic research laboratories, in the arc-lamp room, the optical-test room, and in the dynamo and motor laboratories. The latter are furnished with direct current dynamos of the series, shunt, compound wound and constant current types, as well as with single phase and polyphase generators and motors." The laboratories also contain "electromotors, transmission and absorption dynamometers, a large number of accumulators, transformers, commercial meters, as well as delicate electrical measuring instruments that can be used near dynamos."

(4.) *Course in Chemistry.*—Instruction in the principles, practice, and applications of chemistry are given. The 1*st year* studies consist of: Chemistry; physics (lectures, exercises, and laboratory practice); mathematics (lectures and exercises); engineering drawing and workshop practice; and mechanical laboratory practice. The subjects of the 2*nd year* are: Mathematics, chemical laboratory practice, engineering lectures and exercises; crystallography; engineering design; and organic chemistry (lectures). Special attention is paid to the properties of materials as determined by molecular structure. In the third year the time is devoted principally to chemical laboratory practice. Courses in crystallography and physical chemistry and mathematics are included. Original investigation is encouraged. A fourth year of study is desirable to make a student a "competent independent worker."

58. *City and Guilds Technical College, Finsbury, Leonard-street, City Road, E.C.*:—The City and Guilds Technical College, Finsbury, is another branch of the City and Guilds of London Institute. The terms of admission are: That candidates must be not less than 14 years of age, and must pass an entrance-examination in mathematics and in English—the passing of the Matriculation Examination of the University of London, or of the University of Wales, however, exempts them from this, provided that not more than eighteen months have elapsed since; must produce certificates of good conduct, or other testimony of good moral character, and must attend all the courses of instruction included under the department which they enter. Day and evening courses are provided in (1) Mechanical Engineering; (2) Electrical Engineering and Applied Physics; (3) Industrial and Technical Chemistry; (4) Applied Art. The day courses will be first briefly dealt with.

59. *Day Courses, Technical College, Finsbury.*—All the day courses, with the exception of the course in applied chemistry, which extends over three years, are of two years' duration, and lead to the college certificate if successfully followed. They are communicated by means of lectures, class lessons, laboratory work, drawing office, and workshop practice. These courses, in the words of the calendar, "fulfil the functions of a finishing technical school for those entering industrial life at a comparatively early age; of a supplementary technical college for those who, having had some industrial experience, desire to qualify themselves to become foremen or managers; and of an intermediate college in the educational scheme of the City and Guilds of London Institutes." Admission to the second year course is dependent upon the progress made during the first year. Prizes and scholarships are awarded. A brief reference will now be made to each course.

(1.) *Course in Mechanical Engineering and Applied Mathematics.*—This course includes: Mathematics; practical mechanics; mechanism; mechanical laboratory; exercise work in practical mechanics and mathematics; mechanical drawing; geometry and graphical methods; engineering workshops; physics (lectures and laboratory practice); freehand drawing; geometrical drawing; electricity (lectures and laboratory practice); chemistry (lectures and laboratory practice); and electrical technology.

(2.) *Course in Electrical Engineering and Applied Physics.*—This course is given chiefly by independent laboratory work on the part of the students. The subjects treated are: *Electrical technology*, including lectures on electrical instrument making, galvanometers, electro-magnets, electric bells, primary batteries, thermopiles, lightning conductors, and on dynamo electric machines, electric lighting, electric transmission of power, transformers, arc lamps, glow lamps, accumulators, and advanced methods of electric testing; *practical physics*, special attention being paid to the fundamental laws of physics, the science of heat and the laws of thermo-dynamics and optical instruments; *electrical laboratory* and *physical laboratory* practice. And time also is devoted to mathematics; mechanical, geometrical, and freehand drawing; mechanical laboratory and workshop practice; chemistry.

(3.) *Course in Industrial and Technical Chemistry.*—This course is of three years' duration, but students may qualify for the College certificate at the end of the 2nd year. The course consists of, in the 1st year, chemistry (lectures and laboratory practice); geometrical and freehand drawing; physics (lectures, exercises, and laboratory practice); mathematics and analytical chemistry. In the 2*nd year*, the subjects studied are mechanical drawing; mechanics (lectures, exercises, and laboratory practice); chemistry (lectures, exercises, and laboratory practice); electricity (lecture) and workshop practice. In the 3rd year, the work consists mainly of chemical laboratory practice and lectures in organic and inorganic chemistry.

(4.) *Course in Applied Art.*—Courses in freehand and model drawing are given twice a week.

60. *Evening Courses, City and Guilds Technical College Finsbury.*—The evening courses are intended for "those who are engaged in industrial or commercial occupations in the day time, and who desire to receive supplementary instruction in the application of science and of art to the trades and manufactures in which they are concerned or employed." The work consists of electrical laboratory practice, mechanical drawing, engineering workshop practice, organic chemistry, inorganic chemistry, drawing, design, modelling, enamelling, gold- and silver-smith's work, technical and tapestry painting, etc.; electrical technology lecture (advanced course), mechanical laboratory, practical mathematics, practical mechanics, cabinet-makers' drawing, engineering workshops, practical electro-plating, art furniture, practical geometry, geometrical drawing and machine design, practical physics lecture, and optics. These are the courses provided for the departments of mechanical engineering and applied mathematics, of electrical engineering and applied physics, of industrial and technical chemistry, and of applied art. The

courses

courses are all optional, that is, no course need be followed in its entirety, but subjects need only be selected therefrom, although a complete course of study is recommended. In connection with each course of lectures in mechanics, electricity, heat, and chemistry, there is a corresponding course of practical instruction in laboratory, workshop, or drawing office.

Teachers' Certificates in Domestic Economy, Department of Technology, City and Guilds of London Institute.—The Teachers' Certificates in Domestic Economy issued by the Institute are of three kinds, viz. :—

(1.) The Evening School Teacher's Certificate in the subject of plain cookery or laundry work, or plain needlework or dressmaking or millinery, recognised for evening schools.
(2.) The Elementary Day School Teacher's Certificate in any one of the abovenamed subjects.
(3.) The Teacher's Diploma in Domestic Economy, in either (a) plain cookery, laundry work, house management; or (b) plain needlework, dressmaking and millinery.

Conditions of Award of Certificates in Domestic Economy, City and Guilds of London Institute.—The conditions are as follows :—

Candidates for the Evening School Teachers Certificate are required—

(i) To have passed the examination of the Board of Education (a) for cookery; in hygiene, elementary stage, section I; (b) for laundry work; in inorganic chemistry, alternative elementary stage; (c) for either plain needlework, dressmaking or millinery; in freehand drawing in outline or in geometrical drawing (art).
(ii) To pass each of the prescribed written and practical examinations in the subject selected.
(iii) To offer evidence of having attended a class registered by the Institute, or to have attended a course at a recognised Training School for Domestic Economy.

Candidates for the Elementary Day School Teachers' Certificate are required—

(i) To satisfy condition (1) as for the Evening School Certificate.
(ii) To produce evidence of having either attended for a brief period evening or day classes registered by the Institute or a recognised Training School in Domestic Economy.
(iii) To pass the prescribed written and practical examinations.
(iv) To produce evidence of having taught for at least a period of one year, or to have received adequate instruction and practice in class teaching in a recognised Training School.

Candidates for the Teachers' Diploma in Domestic Economy are required—

(i) To have regularly attended for a period of at least fifty weeks a recognised Training School for Domestic Economy, and to produce evidence of the possession of adequate instruction and practice in class teaching.
(ii) To pass the examinations for the Day School Teachers' Certificate in either (a) plain cookery, laundry work and house management; or (b) plain needlework, dressmaking and millinery.

62. *City and Guilds of London Institute, Department of Technology and Manual Training.*—The various trades guilds, which under the changing conditions of modern civilisation ceased to exercise fully their original functions, and became simply rich corporations, have in late years devoted their accumulated wealth to the development of technical education. The general oversight of this is now vested in a central body, the City and Guilds of London Institute.

The institute is prepared under certain conditions to register classes for instruction in technology and manual training, for the purpose of examination, inspection, and report on the working of the classes.

The registration of these classes is conditional: *First*, there must be approved local committees, each consisting of at least five members, with a chairman and a secretary, and whose functions are (1) to aid in the formation of, to watch the progress of, and to visit these classes; (2) to superintend the examinations, instructions for conducting the examinations being sent to the secretary previous to the date on which the examinations are held; and (3) to distribute the certificates and prizes forwarded from the institute. *Secondly*, a class in order to be registered (1) must be under the direction of a committee of a county or borough council, or technical school, or school board, or other public body; but classes in technological subjects held in any University of the United Kingdom, or in any of the following institutions, viz., the City and Guilds Technical College, Finsbury, London; University College, Bristol; University College, Nottingham; Durham College of Science, Newcastle-upon-Tyne; Firth College, Sheffield; the Royal College of Science for Ireland, Dublin, are considered as registered classes by the institute; and (2) the qualifications of the teacher must be approved by the institute.

The examinations conducted under the superintendence of the Local Committee are usually of two grades, viz. :—(*a*) Ordinary and (*b*) Honours. When the course of instruction extends over three years examinations are held corresponding to each year's course, and a preliminary examination is held in certain subjects. Intending candidates for the examinations are required to apply to their School Secretary, or to the Secretary of the nearest Local Committee, or the Organising Secretary of the Technical Education Committee of the County or County Borough Council, who arrange for their examination and forward their fees to the offices of the Department of Technology, Exhibition-road, London. The examination questions are sent by the institute in sealed envelopes to the custodian appointed to receive them, to be broken in the presence of the candidates at the examination. No candidate may be examined on the same day in more than one subject; and the examination can only take place at the department if applicants have failed to make arrangements elsewhere. In many of the subjects the examination is both written and practical, and in others candidates are required to submit specimens of their work at the examination.

Certificates.—The certificates awarded by the Institute on the results of their examinations are broadly of two kinds, viz. :—The certificate obtained by a candidate, who has not attended any registered class of the department, and the certificates conferred on students who have attended the registered classes of the institute, for the required number of days. These latter are divided into Technological

Certificates and Full Technological Certificates. The Technological Certificates are given for passing either the Ordinary or the Honours Grade of the Examination, and are arranged in two classes, viz., a first and second class; but the Full Technological Certificate is granted only if, in addition to passing in both the Ordinary and Honours Grade, the candidate shews satisfactory knowledge of two science subjects included in the Directory of the Board of Education, South Kensington, cognate to the subject of examination. If, however, the questions of the examination are based on a course of study extending over several years, and a preliminary examination is passed, the passing of the examination held at the termination of each year qualifies for the Full Technological Certificate. In some subjects, passing the preliminary examination is accepted in lieu of one science subject only, and certificates testifying to the passing of the examinations of the Board of Education in geometrical, freehand, and model drawing are also accepted as substitutes for one science subject. A certificate stating that the candidate has passed an examination in the qualifying branches of science at one of the Universities of the United Kingdom or its colonies, is accepted as alternative evidence for the necessary science subjects.

The Teachers' Manual Training Certificate is granted to students who have regularly attended a course of instruction for wood-work and metal-work in a class registered by the Institute, and who have passed the required examination therein.

63. *Courses in the Department of Technology.*—The courses of study on which the examinations of the Institute are based are as follows:—

I. *Salt Manufacture.*—Ordinary grade and Honours grade.

II. *Alkali Manufacture.*—Ordinary grade and Honours grade.

III. *Soap Manufacture.*—Ordinary grade and Honours grade.

IV.**Bread-making and Flour Confectionery.*—Ordinary grade and Honours grade. This examination is both written and practical for each grade, and it presumes both a theoretical and scientific knowledge on the part of candidates.

V. *Brewing.*—Ordinary grade and Honours grade

VI. *Spirit Manufacture and Rectification.*—Ordinary grade and Honours grade.

VII. *Coal-tar and Coal-tar Products.*—This is divided into two sections. The first, dealing with coal-tar distillation, is for the Ordinary grade candidates, the second, coal-tar colouring matters and other products, is for candidates of the Honours grade, as well as the first section.

VIII. *Sugar Manufacture.* –Ordinary grade and Honours grade

IX. *Manufacture of Painters' Oils, Colours, and Varnishes.*—Ordinary grade and Honours grade.

X. *Oils and Fats, including Candle Manufacture.*—Ordinary grade and Honours grade.

XI. *Gas Manufacture.*—Ordinary grade and Honours grade.

XII. *Iron and Steel Manufacture.*—This course extends over three years. the Ordinary grade is divided into two parts. The first, to be taken in the first year, is divided into three sections, viz.:—(1) Iron smelting and puddling; (2) the Bessemer and open hearth processes; and (3) crucible and shear steel and malleable iron castings. The second section, taken in the second year, has the same divisions; so also has the Honours grade in the third year. The first two years must be passed in order to obtain any certificate.

XIII. *Paper Manufacture.*—Ordinary and Honours grade.

XIV.**Photography.*—This examination, both in the Ordinary and Honours grade, is practical and written, and specimen work is required. In each grade there are two sections, viz, pure photography, and photo-mechanical processes.

XV. *Pottery and Porcelain Manufacture.*—The examination in this subject is based on a course of study of three years' duration. There is a Preliminary course, and an Ordinary and Honours, grade. The Preliminary examination is founded on (a) general subjects and (b) applied subjects.

XVI. *Glass Manufacture.*—Ordinary and Honours grade. Candidates, in addition to other things, may be required to make freehand sketches of antique, Venetian, or modern glass, and to be able to design specimens of plain and ornamental glasswork.

XVII. *Dressing of Skins and Manufacture of Light Leathers.*—The Ordinary grade is mainly practical, and the Honours grade is scientific and experimental.

XVIII. *Tanning of Hides and Dressing of Heavy Leathers.*—In the Ordinary grade the knowledge required is mainly practical, and in the Honours grade accurate scientific information and the power of applying it to technical purposes is expected.

XIX.**Boot and Shoe Manufacture.*—This course extends over three years—two years for the Ordinary grade, in which the examination is both written and practical, and one year for the Honours grade, the examination being also written and practical.

XX. *Silk Dyeing.*—Ordinary grade and Honours grade.

XXI. *Wool Dyeing.*—Ordinary grade and Honours grade.

XXII. *The Dyeing of Cotton and other Vegetable Fibres.*—Ordinary and Honours grade.

XXIII. *Cotton and Linen Bleaching and Finishing.*—Ordinary and Honours grade.

XXIV. *Calico and Linen Printing.*—Ordinary and Honours grade.

XXV. *Wool and Worsted Spinning.*—This is a course of three years, viz., two years for the Ordinary grade, and one year for the Honours grade. A preliminary examination in arithmetic, drawing, and elementary physics is required, but the first two years' examinations may be taken in the same year; though it is better to take them in succession.

XXVI.**Wool and Worsted (and Mixed Fabrics) Weaving and Designing.*—This extends over three years—the Ordinary grade two years, and the Honours grade one year. The examination is partly practical and partly written.

XXVII. *Cotton Spinning.*—Duration of course, three years—Ordinary grade, two years; and Honours grade, one year. A preliminary course in arithmetic, drawing, and elementary should be taken.

XXVIII.

XXVIII.**Cotton Weaving.*—Three years is devoted to this course. A preliminary examination has to be passed. The questions of the Ordinary grade relate to the first two years, of the Honours grade to the final year of study. In the Honours grade the questions are on subjects coming under (a) cloth construction, costing and analysis; (b) textile ornament and colouring, principles of ornament; and (c) preparation and weaving mechanism, and mill routine. The examination is written and practical.

XXIX. *Flax Spinning.*—Ordinary grade and Honours grade.

XXX.**Linen Weaving.*—Ordinary grade and Honours grade. The latter is partly written and partly practical.

XXXI. *Silk Throwing and Spinning.*—Duration of course, three years—two years for Ordinary grade and one year for Honours. A preliminary course should be attended in arithmetic, drawing, and elementary physics. The two examinations in the Ordinary grade may be taken in the same year.

XXXII.**Silk, including Ribbon Weaving.*—A three years' course. The examinations in the Ordinary grade are based on the first two years, and the Honours grade on the last year. A preliminary course should be taken in arithmetic and drawing. In the Honours grade, the examination is partly practical and partly written.

XXXIII. *Jute Spinning.*—Ordinary grade and Honours grade. A preliminary course in arithmetic, drawing, and elementary physics should also be attended.

XXXIV.**Jute Weaving.*—The course of instruction is intended to cover three years. The examination in the Ordinary grade is based on subjects of the first two years; in the Honours grade on subjects of the last year. It is advised that a preliminary course in arithmetic, drawing, and elementary physics be attended. An examination is held at the end of each year.

In the Honours grade it is both written and practical.

XXXV. *Lace Manufacture.*—Ordinary and Honours grade.

XXXVI. *Framework Knitting and Hosiery.*—Ordinary and Honours grade.

XXXVII. *Hat Manufacture.*—Ordinary and Honours grade.

XXXVIII. *Telegraphy and Telephony.*—Ordinary grade and Honours grade. The Honours grade is divided in two sections, viz, one for Telegraphy and one for Telephony.

XXXIX. *Electric Lighting and Power Transmission.*—In this course there is a Preliminary, an Ordinary grade, and an Honours grade examination. A certificate in "Wiremen's Work" is given to candidates who pass a practical test in that subject in addition to the Preliminary Examination. In the Ordinary grade, questions are set that pre-suppose an acquaintance with elementary algebra, including quadratic equations and a knowledge of the simple trigonometrical quantities—sine, cosine, etc. In the Honours grade there are three sections corresponding to the three main branches of the electrical engineering industry, viz.—(a) electrical instruments and regulating appliances, etc.; (b) dynamos, accumulators, and transformers, etc.; (c) electric light and power.

XL. *Electro-Plating and Deposition.*—Ordinary grade and Honours grade.

XLI. *Metal Plate Work.*—Ordinary grade and Honours grade. The latter is partly written and partly practical

XLII.**Plumbers' Work.*—This examination consists of two parts—a written examination in the theory and principles of the subject and a practical test of workmanship. Candidates who pass the written examination only, receive a certificate in the "Principles of Plumbing." A preliminary written examination is held after a two years' course of instruction. There are also the usual Ordinary and Honours grades.

XLIII. *Silversmith's Work, including Plate and Plated Wares.*—Ordinary grade and Honours grade. In the former the examination is written merely, but in the latter, candidates are required to submit specimens of practical work.

XLIV.**Goldsmith's Work and Manufacture of Personal Ornaments.*—Ordinary grade and Honours grade. In each grade the examination is partly written and partly practical, and specimen work is required in the Honours grade.

XLV.**Watch and Clock Making.*—The examinations are intended for those engaged as watch and clock makers and repairers, and for those who are engaged in machine factories. In the Ordinary grade no distinction is made between the two classes. The Honours grade examination is partly written and partly practical, and the questions to be answered require more special knowledge.

XLVI**Mechanical Engineering.*—The examination in this course consists of questions based on a three years' course of study. The Ordinary grade is two years and the Honours grade one year. The latter is partly written and partly practical. The practical examination is divided into Machine Designing and Workshop Practice.

XLVII. *Road Carriage Building*—Ordinary grade and Honours grade. In each grade there is an examination in Drawing in addition to the written examination.

XLVIII. *Rail Carriage Building*—Ordidary grade and Honours grade. In each there is a written examination and a Drawing examination.

XLIX.**Typography.*—In this subject a preliminary examination is held for compositors and for Press and Machine candidates; but candidates for either are expected to shew some knowledge of elementary geometry and freehand drawing. In the Ordinary and Honours grade the examinations are both written and practical. The work consists briefly of composing and press and machine work.

L. *Lithography and other Printing Processes.*—A preliminary examination is also held in this course. Candidates should have some knowledge of elementary geometry and freehand drawing. There is an Ordinary grade and an Honours grade.

LI.

LI. *The Raising, Mechanical Preparation, and Dressing of Ores.*—Ordinary grade and Honours grade.

LII.**Mine Surveying.*—An elementary examination is held in this subject. This must be passed by candidates for the Ordinary grade, and candidates for Honours must have previously passed in the Ordinary grade. No high standard of mathematical knowledge is required for the preliminary examination; only as much geometry and mensuration as is needed for solving [very elementary] questions in surveying, together with elementary notions of trigonometry. In the Honours grade, the examination is written, and practical and specimen work is required to be submitted.

LIII. *Slate Quarrying.*—Ordinary grade and Honours grade.

LIV.**Carpentry and Joinery.*—For the sake of apprentices, a preliminary examination is held in this course. This and the examination in the Ordinary grade may be taken in the same year. If necessary, candidates should have attended a two years' course of instruction before presenting themselves for the preliminary examination. The Honours grade is written and practical, and includes drawing and specimen work.

LV. *Ship Carpentry and Joinery.*—This course extends over three years A preliminary course should be taken in "Carpentry and Joinery." Ordinary grade and Honours grade. In the latter, the examination is written and practical.

LVI. *Boilermakers' Work.*—Ordinary grade,—candidates for which are required to do a simple piece of mechanical drawing to shew that they understand the principles on which they are made,—and Honours grade.

LVII.* *Brickwork.*—Ordinary grade (written examination). Honours grade (practical examination on brick-laying and brick-cutting).

LVIII.**Masonry.*—Ordinary grade and Honours grade. The examination is written and practical.

LIX. *Plasterers' Work.* —Ordinary grade and Honours grade. The examination is written and practical.

LX. **Painters' and Decorators' Work.*—The course of instruction covers a period of at least three years. A preliminary examination is held in drawing; mensuration; general principles; brushes; tools, plant and appliances; materials; grounds for painting; painting; distemper; wall-hangings; imitative painting; sign writing and lettering; decorative processes; varnishing; and colouring. In both the Ordinary and the Honours grade, the examinations are partly written and partly practical.

LXI. *Milling (Flour Manufacture).* —Ordinary grade and Honours grade. The course of instruction extends over two years.

LXII. *Cabinet-making.*—Ordinary grade and Honours grade. The latter consists of a written examination, drawing, and practical work.

LXIII.**Book-binding.*—The examination in both the Ordinary and Honours grade consists of two parts, viz.: (a) Forwarding; and (b) Finishing. Candidates are expected to pass in one part only. Each part, also, embraces a written examination and a practical examination.

LXIV. *Dressmaking.*—The examination in dressmaking is practical and written, and includes specimen work done by the candidate in class or at home.

LXV. *Millinery.*—The examination in this subject includes (1) practical work done by the candidate; (2) written answers to questions and drawing; (3) practical work done by the candidate in the presence of the local examiners.

LXVI. *Plain Needlwork.*—The examination includes (1) practical examination; (2) written answers to questions and drawing; (3) specimen work done by the candidate in class or at home.

LXVII. *Plain Cookery.*—This examination includes (1) written answers to questions; (2) practical cookery and scullery work done by the candidates in presence of a local examiner.

LXVIII. *Basket-work.*—The examination in this course includes (1) practical work done by the candidate in the presence of the local examiners; (2) written answers to questions; (3) specimen work done by the candidate during the nine months preceding the examination. There is an Ordinary grade and an Honours grade in this examination.

LXIX. *Builders' Quantities.*—Students, before entering for this examination, should have a practical knowledge of building construction. There is an Ordinary grade and an Honours grade.

LXX. *Wheelwrights' Work, and Van and Cart Building.*—Ordinary grade and Honours grade. In each grade, besides a written examination, there is one in drawing.

Most of the courses extend over two years. Where the courses of instruction are intended to extend over three years, an examination is held at the end of each year, but a certificate is awarded only when the examination of the second year, in addition to that of the first, is passed. In subjects where a knowledge of science is not required, certificates showing knowledge of geometrical drawing, together with freehand or model drawing, form substitutes for the obtaining of the full technological certificate. The preliminary examination is held principally as an encouragement to apprentices to take a complete course of instruction in the subject cognate to their trade.

With regard to the *registration of teachers* by the Institute, those with the following qualifications are entitled to apply:—

(1) Any person who has obtained a full Technological Certificate in the first class of the Honours grade of the subject to be taught, and has passed the practical test, if any.

(2) Any person recommended by the local committee who is recognised by the Board of Education as a teacher of science, and who gives evidence satisfactory to the Institute of having acquired, in the factory or workshop, a practical knowledge of the technological subject to be taught.

(3) Persons, recommended by the local committee, possessing special qualifications to be considered by the Institute for teaching any subject.

64. *The East London Technical College.*—This College was founded in 1882, and owes its origin to a bequest of Mr. J. T. Barber-Beaumont for technical educational purposes. Its work, which consisted principally of lectures on general subjects, was carried on at the Beaumont Hall, Beaumont-square, until about the year 1887, when part of the College, viz., the Hall, was opened by Queen Victoria in the Mile End road, the trustees purchasing the land from the Drapers' Company, and appealing to the public for funds for the purpose. The Drapers' Company also voted the sum of £20,000 for the erection of buildings to be used as a technical school. It was about the year 1894 that the College was brought to its present state of completion, consisting of a hall, a library, technical school, swimming baths, winter garden, and engineering laboratory and workshop. In 1898 the Bow and Bromley Educational Institute was incorporated with the College. The courses are both day and evening, a vast majority of the students attending the evening courses. There is also a day school. The Governors of the College are principally representatives of the Drapers' Company, the Board of Education, London, and the London University.

65. *Day Classes, East London Technical College.*—The conditions of entrance to these classes are that applicants must be not less than 16 years of age and have a good general education. They are open to students of either sex. The courses of study, which are of three years' duration, afford a thorough knowledge of a trade or profession wherein pure and applied science are required, or they may lead to the degree of Bachelor of Science of the University of London after first matriculating. Sometimes a two years' course only is necessary to gain proficiency.

Courses of study.—There are three technical courses, viz:—(1) Chemistry; (2) Engineering; and (3) Electrical Engineering.

CURRICULUM OF COURSE IN CHEMISTRY.

Subjects.	Hours per Week. Year I.
Chemistry Lectures, Inorganic and Organic	3
Chemistry, Practical, Inorganic and Organic	12
Mathematics, Pure and Applied	6
Physics, Lectures	4
,, Practical	4
French or German	1

Subjects.	Hours per Week.	
	Year II.	Year III.
Chemistry Lecture, Inorganic and Organic	2	2
Chemistry, Practical, Inorganic and Organic	16	28
Mathematics (Pure and Applied)	4	...
Physics, Lectures	3	...
,, Practical	4	...
French or German	1	...

The subjects of study for the first year in Mechanical Engineering and Electrical Engineering are identical, and are as follows:—

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Mathematics (Pure and Applied) ...	6	Electrical Engineering	3
Practical Geometry	2	Experimental Laboratory	2
Engineering Drawing and Design ...	4	Workshop	2
Applied Mechanics	4	French or German	1
Physics	6		

COURSE IN MECHANICAL ENGINEERING, 2ND AND 3RD YEARS.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Mathematics (Pure and Applied) ...	6	Physics	2
Practical Geometry	1	Experimental Laboratory	4
Engineering Drawing and Design ...	4	Workshop	4
Applied Mechanics	5	French or German	2

COURSE IN ELECTRICAL ENGINEERING, 2ND AND 3RD YEARS.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Mathematics (Pure and Applied) ...	6	Physics	2
Practical Geometry	1	Mechanical Laboratory	2
Engineering Drawing and Design ...	1	Workshop	2
Electrical Engineering, Lectures ...	2	Magnetism and Electricity, or French or German	2
„ „ Laboratory ...	5		
Applied Mechanics	4		

FINAL B.Sc. PASS COURSE.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Chemistry Lectures, Inorganic and Organic	2	Mathematics (Pure and Applied) ...	8
Chemistry Practical, Inorganic and Organic	8	Physics, Lectures	8
		„ Practical	6
		French or German	2

This course is modified for those students who desire to take Honours in Mathematics or Physics.

66. *Evening Classes, East London Technical College.*—These classes afford instruction for students of either sex of not less than 16 years of age; apprentices and boys, however, who have attended the Day School are admitted at the age of 14. Students are prepared for the higher examinations of the Science and Art Department of the Board of Education.

Besides the ordinary technical courses, there is a special course leading to the Science degrees of the University of London, the provision for which being a Matriculation Course, the examination in which must always be passed three years before sitting for the Final B.Sc. Examination; an Intermediate Science Course extending over one or more years, and consisting of courses in chemistry, physics, mathematics and mechanics, mechanical engineering and electrical engineering; and a Final B.Sc. Course, spreading over two or more years and consisting of pure mathematics, applied mathematics, physics (lectures and practice), chemistry (inorganic and organic lectures and practice), mechanical engineering (lectures and laboratory practice), electrical engineering (lectures and laboratory practice).

To the various classes in Science and Technology only those students are admitted whose previous education has been such as to enable them to benefit from the instruction given. The courses of instruction are as follows:—

I. *Pure Mathematics*, which is divided into seven stages beginning with elementary mathematics and terminating with the more important applications of the infinitesimal calculus to the higher branches of pure mathematics.

II. *Applied Mathematics.*—This course is also treated in seven stages, the time being mainly devoted throughout to the statical and dynamical properties of solid and liquid bodies without the use of the differential or integral calculus.

III. *Physics*, given by means of lectures illustrated by experiments and lantern slides and laboratory practice.

IV. *Chemistry.*—The subjects of this course are elementary and advanced inorganic and organic chemistry, the instruction being given by means of lectures and laboratory practice. There is a laboratory where research work may be carried on and where special and advanced practical work may be pursued. Elementary mathematics and physics should be studied in conjunction with chemistry.

V. *Engineering*, Comprising geometrical drawing, elementary and advanced geometry, elementary and advanced machine construction, elementary and advanced applied mechanics, elementary and advanced steam, experimental laboratory, engineering workshop, pattern-making, and smith's work. The laboratory contains a 50-ton Wicksteed testing machine, a 5,000-lb. Bailey tester, and engines and indicators, workshops fitted with lathes of various descriptions, planing machines, and numerous vices.

VI. *Building Construction*, including carpentry workshop practice and lectures, manual training and plumbing.

VII. *Electrical Engineering*, comprising magnetism and electricity (elementary and advanced), elementary and advanced electrical engineering, practical wiring, scientific instrument making. There are laboratories for dynamo work, instrument testing, electrical instrument making, and electric wiring. The instruction given is in every respect thorough.

Evening Courses in Art, East London Technical College.—The instruction embraces drawing and shading from the flat and round, in chalk, sepia, monochrome and colour; design; plant drawing; still life and flower painting; modelling in clay and wax, and decorative work in coloured plaster; wood carving; bookbinding; furniture design; and drawing from the antique and life. A Sketch Club is a feature of the School for out-of-door painting and the study of composition.

There is a Gymnasium in connection with the evening classes of the College, and also classes for French and German.

67.

67. *Day School, East London Technical College.*—The Day School of the East London Technical College exists for providing instruction to boys of from 12 to 16 years of age, and is designed to meet the requirements of those who intend to take up a handicraft or enter chemical or manufacturing works. It prepares pupils for the London Matriculation Examination and for the examinations of the Science and Art Department of the Board of Education. The School meets daily, excluding Saturday, from 9 a.m. to 4 p.m., and the School-year is divided into three terms of about thirteen weeks each. The course of study is three years, and is as follows:—

FIRST YEAR'S COURSE.[1]

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Mathematics	6	Machine or Building Drawing ...	4
Physics (Theoretical and Practical) ...	5	Manual Instruction	2
Chemistry (Theoretical and Practical) ...	3	French	3
Freehand Drawing	1	English History and Composition ...	3
Practical Geometry	3	Gymnastics	1

SECOND YEAR'S COURSE.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Section A (Mechanical).		*Section B (Physical and Chemical).*	
Mathematics	5	Mathematics	5
Practical Geometry	4	Physics (Theoretical and Practical) ...	4
Mechanics (Theoretical and Applied) ...	4	Inorganic Chemistry (Theoretical and Practical)	6
Machine or Building Drawing	5	Mechanics...	2
Manual Instruction	2	Organic Chemistry	1
Physics (Theoretical and Practical) ...	4	Practical Geometry	4
French or German	4	Manual Instruction	2
History, English Composition and Geography	3	French or German	3
Gymnastics	1	History, English Composition and Geography	3
		Gymnastics	1

THIRD YEAR'S COURSE.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
Section A (Mechanical).		*Section B (Chemical).*	
Mathematics	7	Mathematics	4
Practical Geometry	5	Physics (Theoretical and Practical) ..	4
Machine or Building Drawing	4	Inorganic Chemistry (Theoretical and Practical)	13
Mechanics (Theoretical and Applied) ...	5	Organic Chemistry (Theoretical and Practical)	4
Steam	2	Manual Instruction	2
Manual Instruction	4	French or German	3
French or German	3	Gymnastics	1
Gymnastics	1		

68. *Classes at the Bow and Bromley Branch of the East London Technical College.*—As above stated, the Bow and Bromley Institute was incorporated with the East London Technical College in 1898. There is a specially equipped laboratory for the teaching of botany, physiology, and hygiene. The other subjects studied are:—Physiography, tailor's cutting, millinery, dressmaking and dress-cutting, ambulance, subjects for the Civil Service examinations, shorthand, book-keeping, elocution, the theory of music, and vocal and instrumental music, and physical culture. These courses are mainly evening.

69. *The South-western Polytechnic, Chelsea, S.W.*—*Day College for Men.*—This College exists for the purpose of giving instruction to youths above the age of 16 and to men. The courses are each of three years' duration, and candidates for admission to the technical courses are expected to be equipped with a sound English education, together with an elementary knowledge of mathematics and, if possible, of physics and chemistry. The students are divided into (a) matriculated students, and (b) occasional students. The former consists of those who are admitted to a complete course of study of ten to thirty hours a week, and the latter are those who may take any particular subject or subjects without being obliged to attend a complete course.

Three free studentships, tenable for three years, are awarded on the results of the entrance-examination to candidates between the ages of 16 and 20, provided they shew sufficient merit.

Certificates are granted to students of the College, but only those who have regularly attended during a whole session a complete course in any subject are eligible to compete. They are of two kinds, viz., a *Certificate of Distinction,* awarded to those obtaining 75 per cent. of the total number of marks obtainable, and a *Certificate of Merit,* presented to those obtaining 55 per cent. The

[1] Pupils may repeat this course in their second year, doing more advanced work, however, in each subject.

The College diploma is granted to *Matriculated* students who have successfully pursued a three years' course in mechanical, civil, or electrical engineering, or applied chemistry.

Fees.—The fees per session, payable in advance, are as follows:—

For 10 hours per week, £7 10s.; for 15 hours per week, £10; for 20 hours per week, £12 10s.; and for 30 hours per week, £15.

70. *Courses of Study, Chelsea Polytechnic.*—The technical and science courses provided in this Institute, consisting of mechanical and civil engineering, electrical engineering, mathematics and physics, and chemistry and metallurgy, lead either to the diploma of the College after a three years' course of study as above stated, or to the degree of Bachelor of Science (B Sc.) of the University of London after matriculation, and a three years' course of study. Candidates for this degree are designated as *internal* students of the University, because they are registered, and their courses of instruction are approved by, and their teachers are recognised as teachers of, the University. There are also students designated as *external* students of the University, to whom, however, it bears merely the relation of an examining and degree granting body.

The Matriculation Examination for *internal* students consists in the passing of five subjects, as follows:—(a) English; (b) elementary mathematics; (c) one of the following subjects:—Latin, or elementary mechanics or elementary physics—heat, light, and sound, or elementary chemistry, or elementary botany; (d) two of the following, neither of which has already been taken in previous section. If Latin be not taken, one of the other subjects selected must be another language:—Latin, Greek, French, German, Arabic, Sanskrit, Spanish, Portuguese, Italian, Hebrew, ancient history, modern history, logic, physical and general geography, geometrical and mechanical drawing, mathematics (more advanced), elementary mechanics, elementary chemistry, elementary physics—heat, light, and sound, electricity and magnetism, elementary biology, botany, and zoology. The other examinations are—the Intermediate Examinations and the Final Examinations, the latter taking place upon the completion of the three years' course for the B.Sc. degree. In certain of the courses there is no distinction made between the diploma and the degree courses.

The Diploma and University Engineering and Science Courses are as follows:—

71. *Course in Mechanical Engineering.*—In this subject the courses for the degree are distinct from those of the diplomas. The instruction provided in mechanical engineering is of a theoretical and practical character, and is suitable for those who desire to enter the works or office of an engineer, or for those who, after a practical training in a workshop, desire to gain technical knowledge. For the diploma course during the *first year* the subjects studied are—Engineering drawing, physics (lectures and laboratory practice), mathematics, theoretical and applied mechanics (lectures and laboratory practice), workshops, chemistry (lectures and laboratory practice), electricity and magnetism, electrical laboratory, applied mechanics, mechanical exercises, machine construction (lecture), electrical exercises, electrical technology, practical geometry. In the *second year* the instruction embraces—Engineering drawing and design, mathematics, chemical lecture, theory and design of machines or surveying, workshop practice, electrical technology, electrical calculation, mechanical engineering, heat engines, electrical design, electrical laboratory, mechanical laboratory, electrotechnics, metallurgy and metallurgical laboratory (during third term electrical laboratory). For the *third year* the subjects are—Design, electrical engineering (lecture and laboratory), mathematics, theory of machines, workshop practice, hydraulics, electrical technology, mechanical laboratory, strength and elasticity of materials, electrical design, electrical laboratory or design, heat engines, and theory of structures.

72. *Course in Electrical Engineering.*—This course may either precede or follow practical experience in workshops. During the third year, opportunity is given for specialisation. The diploma and degree courses are identical. The instruction afforded in the first and second year is identical with that in Mechanical Engineering. The subjects of the *third year* are—Electrical design drawing, electrical technology, electrical laboratory, mathematics, theory of machines, alternating currents, electrical problems, lectures in electrical design, mechanical laboratory, heat engines, theory of structures.

(The courses in Mathematics and Physics offer alike to University students and to technical students means of acquiring a sound knowledge of those physical principles and those branches of mathematics indispensable to the intelligent study of modern engineering and industrial problems. The practical work in the physical laboratories is intended to develope skill in the accurate measurement of important physical quantities, and to familiarise students with the employment of instruments of precision.)

73. *Course in Chemistry and Metallurgy.*—The courses of instruction in Chemistry are arranged: (1) For students who wish to become industrial, consulting, or analytical chemists; and (2) for University students. The courses in Metallurgy afford a knowledge of the properties of metals, ores, and alloys, and of assaying, particularly of gold and silver. There are, it is stated, well-equipped laboratories for elementary and advanced work, in which instruction is given in chemical manipulation, in qualitative and quantitative analysis, in the preparation of pure chemicals, and in the methods of investigation and research. For practical instruction in metallurgy there is a furnace-room containing wind and muffle furnaces suitable for metallurgical operations and dry assays; and rooms for weighing, conducting blow-pipe work, and wet assays. The laboratory has facilities for gold and silver assaying. During the *first year* the time is devoted to—chemical laboratory, the principles of chemistry, heat, light, and sound lecture, physical laboratory, mathematics, elementary mechanics, chemical exercises, chemistry (lecture, magnetism and electricity, electrical laboratory, workshops or physical laboratory, electrical exercises, metallurgical lecture or laboratory, geometry or metallurgical laboratory. In the *second year* the instruction includes: geology, practical mineralogy and geology, mineralogy (lecture), organic chemistry. physical or chemical laboratory, mathematics, chemical lecture, metallurgical lecture, metallurgical or chemical laboratory, chemical laboratory, electrical laboratory, workshops or theoretical mechanics, mathematics or chemical laboratory. During the *third year* the work consists principally of chemical laboratory work.

74.

74. *Courses in Biology and Geology.*—These courses comprise botany, summer course in practical plant physiology and ecology; zoology; elementary and advanced geology and mineralogy, and a course in Materia Medica suitable for minor pharmaceutical students.

75. *Courses in Languages, Literature, History and Logic.*—These courses include: English and dramatic literature, English (grammar, composition, essay and précis-writing); English and European history; English literature; Anglo-Saxon and early English dialects; logic; Foreign languages (including French, German, Spanish, Latin, and Greek).

76. *Course in Commerce.*—This course extends over two years. The subjects studied during the first year are:—Business methods, commercial geography, book-keeping and arithmetic, two modern languages, English literature and composition, commercial history and mathematics. During the second year the instruction consists of: Mercantile law, principles of economics and economic history, commercial geography, book-keeping and arithmetic, two modern languages, mathematics, machinery of business. Chemistry, shorthand, typewriting, and freehand and geometrical drawing are regarded as optional subjects.

The University of London grants Science Degrees in the Faculty of Economics and Political Science, including Commerce and Industry, and suitable courses are available at the Polytechnic for the Matriculation Examination and for the Intermediate Science (Economics) Examination. Some of the classes are also suitable for the Final Examination for the degree of Bachelor of Science (Economics).

A *School of Art* and a *School of Music* are also connected with the Polytechnic.

77. *South-Western Polytechnic, Chelsea, S.W., Day College for Women.*—The provision made for the technical education of girls above the age of 16 in this Institution is of a varied character. The following is but a brief description, but sufficient to convey an idea of the kind of instruction aimed at in the teaching. The *Courses of Study* are as follows:—

I. *Course in Home Training and Domestic Science.*—This course, it is stated, "is intended as a *specializing* school for women who wish to study the special work of women as keepers of house or home." It includes the following, viz.:—(a) Three courses for cookery by demonstrations and practice: the first being devoted to plain household cookery; the second to superior household cookery; and the third to advanced cookery. (*b*) A course of six lectures in *household chemistry*, and instruction in household sewing, housewifery and household management, laundry work, dress-cutting and making and millinery; and (c) the *St. John's Ambulance* course in first aid and sick nursing, hygiene and physiology, household book-keeping, and gymnastics.

II. *Course in Mathematics and Physics.*—The subjects studied under *mathematics* are (a) the rudiments of arithmetic; (b) the elements of arithmetic, geometry, algebra, and mensuration; (c) mathematics for the matriculation examination; (d) intermediate mathemathics, including algebra, geometry, and trigonometry; (e) advanced mathematics, viz., algebra, geometry, and differential and integral calculus; (f) applied mathematics, embracing matriculation mechanics, (lectures, and practical work), intermediate mechanics (lectures and practical work), and advanced applied mathematics (lectures and exercise work.) [The matriculation, intermediate, and advanced work, apply, as already explained in a former section, to the examinations of the London University for the degree of Bachelor of Science, conferred after a four years' course, including matriculation. The candidates for the degree attending this College are called *Internal* students of the London University.] The subjects studied under *Physics* are: (a) heat, light, and sound; (b) electricity and magnetism, viz., magnetism, electrostatics, current electricity, electro-magnetism (lectures, exercises, and practical work); (c) intermediate experimental physics, viz., heat, sound, light, magnetism and electricity, energy, etc. (lectures and practical work); (d) advanced physics (lectures and practical work).

III. *Course in Chemistry.*—This course extends over three years for non-University students and over four years including matriculation for University students, that is for those who are studying for the B.Sc. Degree. The laboratories are well equipped, and there are special rooms for gas and water analysis, electro-deposition and research. For the *first year* the subjects studied are:—Chemical laboratory; principles of chemistry; heat, light and sound; physical laboratory; mathematics; elementary mechanics (lecture); chemical exercises; chemistry (lecture); magnetism and electricity (lecture); electrical laboratory; electrical exercises; and geometry. For the *second year* the subjects are:—Geology (lecture); practical mineralogy and geology; mineralogy (lecture); organic chemistry (lecture); physical or chemical laboratory; mathematics; chemical lecture; metallurgy lecture; metallurgical or chemical laboratory; chemical laboratory; electrical laboratory; workshops or theoretical mechanics lecture; workshops or physical laboratory; mathematics or chemical laboratory. In the *third year* the instruction comprises—principally chemical laboratory practice and lectures in organic and physical chemistry.

IV. *Courses in Biology, Geology, and Hygiene.*—The courses in biology and geology are suited to the requirements of candidates for the Examinations of the University of London, of the Pharmaceutical Society, etc. The subjects of instruction are:—Botany (lectures and practice); summer course in practical plant physiology and ecology, including experiments and excursions; zoology lectures and practice; Materia Medica, elementary and advanced; geology and mineralogy (lectures and practice); physiology (lecture and practice); practical histology; elementary and advanced hygiene.

V. *Courses in Languages, Literature, History, and Logic.*—The languages taught are French, German, Spanish, Latin, and Greek. The other subjects of instruction are:—English and dramatic literature; English, including English grammar, English composition, essay and precis writing; English and European history; and Anglo-Saxon and early English dialects; and Logic. The requirements of the University of London and other Public Examinations are held in view in each subject taught.

VI.

VI. *Course in Commerce.*—The following course is recommended :—

1st Year.—Business methods ; commercial geography ; book-keeping and arithmetic ; two languages, viz., French and German ; English literature and composition ; commercial history ; mathematics.

2nd Year.—Mercantile law ; political economy and economic history ; commercial geography ; book-keeping and arithmetic ; two languages, viz., French and German ; mathematics. *Optional subjectr :* Chemistry ; shorthand ; typewriting ; freehand and geometrical drawing. The same remarks as to degrees apply as for Day College for Men. For women who wish to take positions as secretaries or clerks the course proposed is as follows :—Commercial arithmetic ; book-keeping ; correspondence and business methods ; economics ; English composition ; French ; German ; typewriting and shorthand. Students are prepared for the examinations of the Society of Arts, the London Chamber of Commerce, and the Civil Service.

VII. *Course in Art :* including elementary, intermediate, and life classes ; costume model ; black and white class, and modelling class.

VIII. *Course in Physical Culture :* including a gymnastic class ; Swedish gymnastics ; fencing class ; gymnastics for children ; dancing class for girls and children ; hockey, cricket, or tennis ; and riding lessons. There is also a gymnastic training course of two years' duration.

As in the Day College for Men, the students are either Matriculated or Occasional, the former taking a complete course of study and the latter taking only special subjects. No entrance examination is required. There is an examination, however, for those who desire to compete for the three free studentships offered by the College. The hours of attendance are from 10 a.m. to 5 p.m.

Fees.—The fees, payable in advance, are as follows :—

£3	per term	or £7 10s.	per session	for 10	hours	per week.
£4	"	" £10	"	" 15	"	"
£5	"	" £12 10s.	"	" 20	"	"
£6	"	" £15	"	" 30	"	"

78. *Evening Courses, The South Western Polytechnic, Chelsea.*—These courses are designated terminal and sessional—that is, a student may either attend for a term or for a session ; if the latter, he is expected to undergo the examinations of the Board of Education at its close. The college is open every week-day evening from 6 to 10·15. Certificates are granted for attendance, and for marks obtained at the examinations, viz., *Certificate of Distinction* to those who obtain 75 per cent. of the total number, and a *Certificate of Merit* to those obtaining 55 per cent.

As in the day colleges, courses of study are provided leading to the degree of Bachelor of Science in the University of London—first matriculation courses, and then those for the three years following this examination. It is unnecessary to treat these in detail.

79. *Battersea Poytechnic, South London.*—The Battersea Polytechnic was founded in 1894, and is an outcome of the work of the South London Polytechnics Committee. It receives annually from the City Parochial Foundation a sum of £3,500, and from the London Technical Education Board about £4,000. The work of the Institute consists mainly of evening courses for both sexes in all subjects of technology, pure and applied science, art, commerce, domestic economy, and music. In addition, it has a technical day school, a science day school for boys and girls, a training school of domestic economy, a domestic economy school for girls, a day school of art, and special day courses in science and technical subjects.

There are to be found in the institute well-equipped workshops for engineers, smiths, carpenters and joiners, pattern-makers, plumbers, bricklayers, masons, plasterers, and painters and house-decorators ; laboratories for engineering and mechanics, electrical engineering, physics, chemistry, and natural science ; well-fitted art school, cookery schools, laundry, needlework rooms, photographic rooms, and ordinary lecture and class rooms. There are also separate gymnasia for men and women, a reference library, well-furnished common rooms, reading room, refreshment rooms, and a great hall.

80. *Courses of Study for Beginners, Battersea Polytechnic.*—The following are the courses of study for beginners, for which provision is made in the Polytechnic, viz. :—

Mechanical Engineering—

Science.—Mensuration, mathematics, practical geometry, freehand drawing, applied mechanics, theoretical mechanics, heat, steam, machine drawing.
Trade.—Fitting and machine shop, smiths' work, pattern making.
General.—General physics, magnetism and electricity, inorganic chemistry.

Bricklaying and Masonry—

Science.—Mensuration, mathematics, practical geometry, freehand drawing, building construction builders' quantities, mechanics.
Trade.—Brickwork and masons' work.
General.—General physics, inorganic chemistry.

Plastering-

Plastering—

Science.—Mensuration, practical geometry, building construction, freehand drawing, and modelling.

Trade.—Plasterers' work.

Plumbing—

Science.—Mensuration, mathematics, practical geometry, building construction, builders' quantities, theoretical mechanics (fluids), heat, inorganic chemistry, applied mechanics.

Trade.—Plumbers' work.

General.—General physics, hygiene.

Carpentry and Joinery—

Science.—Mensuration, mathematics, practical geometry, building construction, builders' quantities, applied mechanics.

Trade.—Carpentry and joinery, staircasing and handrailing.

Painting and House Decorating—

Art classes in freehand drawing and design, practical geometry, building construction.

Cabinet-making—

Art classes in freehand and design, practical geometry.

Electrical Engineering—

Science.—Mensuration, mathematics, practical geometry, freehand drawing, magnetism and electricity, theoretical mechanics, heat, electric lighting and power transmission, steam, applied mechanics, machine drawing, building construction (for wiresmen).

Trade.—Electrical workshop, wiring and house fitting.

General.—General physics, inorganic chemistry.

Chemical Engineering—

Mathematics, inorganic chemistry before technical work, theoretical mechanics (fluids), sound, light and heat, magnetism and electricity.

Photography—

Inorganic chemistry, light.

81. *Evening Courses, Battersea Polytechnic.*—The courses are as hereunder:—

In the Department of *Mechanical Engineering and building trades*, the courses are:—(1) Applied mechanics; (2) Steam and heat engines; (3) Municipal and civil engineering drawing and design; (4) Land surveying (summer course); (5) Practical sanitary science; (6) Builders' quantities and estimating, drawing office and mechanical laboratory; (7) Drawing; (8) Practical geometry for beginners; (9) Practical plane and solid geometry; (10) Building construction and drawing; (11) Special courses for students of advanced building construction; (12) Machine construction and drawing.

In this Department students are coached for the B.Sc. Degree of the London University, the examinations of the City and Guilds of London Institute, and for the Examination for the Associate Membership of the Institution of Civil Engineers, and every facility is afforded them for study in the way of well-fitted laboratories and workshops and ably delivered lectures.

In the *Trade Classes* the courses provided are:—(1) Fitting and machine shop; (2) Smiths' work; (3) Drawing and plate-work for boilermakers and metal-plate workers; (4) Cycle and motor construction; (5) Pattern-making; (6) Carpentry and joinery; (7) Staircasing and handrailing; (8) Brickwork; (9) Masons' work; (10) Plumbers' work; (11) General trades, *e.g.*, tailor cutting for men. Practical Examinations are conducted by the City and Guilds of London Institute.

82. *Courses in Physics and Electrical Engineering.*—The course in physics includes general elementary physics, magnetism and electricity, heat, light and sound, special laboratory work in magnetism and electricity and heat, light, and sound. The course in electrical engineering includes, as well as the usual lectures, electric wiring and house-fitting. The instruction is given in the general physics laboratory—the electrical laboratory and the electrical testing-room and workshop being well fitted up for the purpose—by means of lectures, laboratory and workshop practice. Students are prepared for the examinations of the University of London and for the examinations of the Science and Art Department of the Board of Education. Certain courses are adapted for the Final B.Sc. Degree of the London University, and opportunity is given for research and special laboratory work.

83. *Course in Inorganic, Organic, and Technological Chemistry.*—There are four year courses in inorganic and physical chemistry, the last being an honours course; and three year courses in organic chemistry. The technological courses include—(*a*) Gas manufacture; (*b*) Oils, fats, soaps, and candles; (*c*) Special summer course in gas analysis; (*d*) Assaying (iron and steel analysis and blowpipe analysis); (*e*) General technical and commercial analysis; (*f*) Paper-making; (*g*) Paper-testing; (*h*) Chemistry for builders; (*i*) Chemistry of foods, cookery, and laundry work.

Certain of the courses are adapted for the Examinations of the London University. Students attending these are called "Internal" students of the University, *i.e.*, if they have Matriculated. Facilities are afforded students for research and special laboratory work.

84.

84. *Other Courses, Battersea Polytechnic.*—The courses in ***Pure and Mixed Mathematics, Theoretical Mechanics, and Technical Mensuration*** are designed for students who wish to prepare for the Science and Art Department of the Board of Education and for the various examinations of the London University, leading to the B.Sc. Degree. This instruction is imparted by means of lectures and laboratory practice.

The course in *Natural Science*, including botany, hygiene, human physiology, physiography and photography is intended for students preparing for the examinations of the Science and Art Department of the Board of Education and of the London University. The laboratory for botany and physiology is well equipped. Excursions are made to various gardens.

The courses in the *Art Department* comprise preparatory and elementary courses in light and shade, model and freehand drawing; perspective and geometrical drawing: elementary design; practical plane and solid geometry; life courses; modelling in clay and wax; art needlework; special courses in design; principles of ornament; lettering; art class teachers' certificate course; special art courses, for teachers only, in preparation for the elementary drawing certificate; trade courses, including carving in wood, stone, or marble; painters and house decorators' work; and plasterers' work.

"The general scheme of Art Instruction," says the Calendar, "will comprise a thoroughly practical knowledge of designing, drawing, painting, and modelling, especially in its various applications to trades and industries (the building trades, decorating and painting, mosaic, cabinet-making, book-binding, pattern designing for wall-papers, prints and woollen fabrics, dressmaking, art needlework, and special classes on technical, art, viz., art needlework, modelling, carving in wood, stone, and marble, plaster-work, house painters and decorators' work)."

The courses in *Language, Commerce, and General Subjects*, embrace Latin; English and French for Matriculation; French; German; Spanish; commercial arithmetic, book-keeping; shorthand and typewriting; and such higher commercial subjects as the principles of commerce in the making, sharing, and exchange of wealth, with the theory of exchange and taxation. Students are coached for the Civil Service Examinations. The general subjects are elocution and physical culture.

The courses in the *Music Department* comprise (1) vocal music, including sight-singing, choral singing, a course in preparatory voice-production and solo singing; (2) instrumental music, viz., tuition in the violin, orchestral band, mandoline, mandoline and violin band, and the pianoforte; (3) theory of music.

The courses for *Women* comprise cookery; plain needlework and cutting-out; dress cutting and making; home dress-making; ladies' tailoring (suitable for professional dress-making); millinery; laundry; upholstery; musical drill and gymnastics. For the carrying out of this work, there are well-equipped cookery schools, needlework rooms, and laundry, a well-fitted gymnasium, and comfortably-furnished common rooms.

This concludes the evening courses in the Battersea Polytechnic.

85. *Day Courses, Battersea Polytechnic.*—The day courses comprise (1) French; (2) technical and science courses, viz., pure mathematics, technical mensuration, practical mathematics, practical plane and solid geometry, machine construction and drawing, building construction and drawing, applied mechanics, steam and heat engines, elementary general physics, electricity and magnetism, advanced physics, electrical engineering, and workshop practice; (3) special college courses for technical students of one or two years' duration, viz., mechanical engineering, electrical engineering, chemical industries, and architectural and constructional work; (4) artisan courses in preparation for the building and engineering trades; (5) science courses for boys and girls; (6) courses in commerce and general subjects for girls; (7) course in domestic economy for girls; and (8) training course in domestic economy for teachers. The subjects of the two last courses being cookery, needlework, dressmaking, millinery, laundry-work, housewifery. There are also certain day courses provided in connection with the departments of mechanical engineering and building trades, physics and electrical engineering, chemistry, mathematics, art, music, and the women's department; the evening courses of which have been outlined above. There are afternoon courses in ladies' tailoring and fancy dressmaking, millinery, embroidery and fancy needlework, musical drill and gymnastics, and a "First Aid" course for ladies. There is a special Saturday morning class in advanced physics and in elementary electrical engineering, and a special course in chemistry on Wednesday afternoon.

Students in science and engineering may work for the degree of B. Sc. awarded by the London University. They must first of all pass the matriculation examination and then enter on a three years' course of study approved by the University. Students attending either the evening or day courses may be candidates, and are called "Internal Students of the University," because their courses are approved and their teachers recognised by the University of London, as elsewhere explained.

86. *The Birbeck Literary and Scientific Institution.*—This institution, at Bream's Buildings, Chancery-lane, London, E.C., was founded by Dr. George Birbeck, in 1823, to give "instruction to students in the principles of the arts they practise, and in the various branches of science and useful knowledge." It has day and evening courses in departments such as (1) Arts (Faculty of); (2) Science (Faculty of); (3) English and Commercial; (4) Languages; (5) Law and Mental Science; and (6) Science. It has also (7) a School of Art, and (8) of Music.

The subjects taught are:—

(1) Latin, Greek, mathematics, logic and psychology, English, French.

(2) Chemistry, physics, mathematics, botany, geology, zoology, psychology, commercial geography, political economy.

(3) Arithmetic, book-keeping, commercial geography, economics, English language and composition, English literature and Anglo-Saxon, English history, elocution, shorthand, Civil Service, matriculation subjects.

(4) Latin, Greek, B.A. standard, and matriculation standard, French, German, Italian, Spanish, Russian, French, and German literature.

(5) Conveyancing, equity, commercial law and bankruptcy, common law, reading for LL.B., intermediate and final, logic, psychology, and ethics.

(6)

(6) Botany, biology, zoology, physiology, building construction, chemistry, experimental physics, practical geometry, geology and mineralogy, mathematics pure and mixed, theoretical mechanics, applied mechanics, machine construction and drawing, metallurgy, principles of mining, steam, photography, land surveying, practical estimating, quantity surveying, ambulance.

(7) Elementary, advanced, geometrical, perspective and architectural drawing, elementary, advanced, and Honours design, drawing, painting, and modelling from life, painting in water colour, tempera, oil, etc., sketching from nature, black and white for press work, wood carving, and cabinet joinery, metal work repoussé, etc., wood staining and inlaying.

(8) Vocal music, pianoforte, organ and harmonium, violin and violoncello.

The character of the work is very similar to that of other technical institutions; it ranges from the grade of University work proper downwards.

87. *The Municipal Technical School, Birmingham.*—The municipal technical school in Suffolk-street, Birmingham, is both a day and an evening school. The day school is for boys between the ages of 12 and 17 years, the object aimed at being to give them a "general modern education, specially fitting them to take part in and to develope the manufactures and other industries of the town. *The courses of study are more scientific in character than those of the grammar schools*, and the standard of instruction is more advanced than that of the higher grade Board Schools, and less advanced than that of the Birmingham University." Special attention is given to the scientific and workshop training of students, and their general education is not neglected. During the first two years, the work is of a preparatory nature, and in the last two years gradual specialisation in those subjects likely to be of most service to students is permitted.

The *Day School* is divided into three sections, viz.:—

I. *Preparatory*, in which are studied English, including grammar and composition, geography and history; French, mathematics (arithmetic, algebra, and experimental geometry), experimental physics and chemistry, and work in the wood and iron workshops. In this course, only the elements of these subjects are studied.

II. *School of Science.*—Two years as a rule are spent in this section. The subjects of study are:—

(a) *English*, including literature and composition, commercial geography and industrial history.

(b) *Mathematics*, including arithmetic, contracted and mechanical methods of calculation, algebra (up to and including quadratic equations). Euclid (books I and II), and elementary trigonometry, French (grammar, composition, and conversation).

(c) *Science.*—Quantitative experimental work in mensuration, heat, mechanics, elementary magnetism and investigations, chiefly quantitative, into the chemistry of a number of common substances, all knowledge being obtained from actual experiments by the pupils, no text-books being used.

(d) *Mechanical Drawing.*—Practical, plane, and solid geometry, machine details.

(e) *Manual Instruction.*—Wood and iron work.

Two years, as above mentioned, are usually devoted to this course, although in rare cases it is completed in one year. An entrance-examination must be passed, and a thorough knowledge must be possessed of the work prescribed for Standard VI in the Elementary Education Code or its equivalent.

III. *Technical Course.*—The technical course is also of two years' duration, and is based on the scientific work of Section II. Instruction is given in the two main divisions of Applied Science, viz.,:—(a) Engineering (mechanical and electrical); and (b) Applied Chemistry. The student may select either course. The *Engineering Course* comprises machine construction and design, steam, applied mechanics, and engineering laboratory work, including the elements of surveying, electrical measurements, experimenting with electrical machinery, and with heavy currents. The *Applied Chemical Course*, comprises a comprehensive course of quantitative and qualitative analyses in the second year, analyses and experimental work of a technical character; metallurgical processes and methods are practically studied, and also the foundations of organic chemistry.

Students in this course continue also to further study French and German, as well as such Mathematics and Experimental Physics as are necessary to his work.

The fees are £3 per annum, payable in advance. No boy can commence a new sessions' work, after attaining the age of 17. The classes meet daily, from 9 to 12·30 in the morning, and from 1·15 to 4 in the afternoon, except on Wednesday and Saturday, when the classes are held in the morning only.

The Head-master, at the end of every session, endeavours to find suitable openings for boys who have completed their course.

There are three types of scholarships awarded, viz.:—(a) Entrance Scholarships; (b) Internal Scholarships; and (c) the Priestley Scholarship.

88. *The Technical Evening School, Birmingham.*—The chief purpose of this school is to provide a type of education of service to all the local trades. The opportunity is afforded students of handling tools, and of learning trade processes in the workshop instruction that would not be given them in their daily work. They also receive a knowledge of the scientific principles on which the local industries are based. The teaching is prosecuted by means of lectures, illustrated by experiments, as well as by laboratory and workshop instruction. Systematic instruction is given in both Pure and Applied Science.

The *fees* are almost nominal. Only 2s. 6d. is charged for a lecture or drawing class for the whole session; the combined fee for a laboratory or workshop class, together with an approved lecture or drawing class, is 5s. These are payable in advance. The teachers and assistants in the school are

admitted

admitted free to all classes. Where a group of subjects is taken the fees are reduced, as—Artisan or Workshop Courses: First stage, 5s.; second stage, 7s. 6d.; third stage, 10s. Technical or Science Courses: Junior, 7s. 6d.; advanced, 10s.; senior, 12s. 6d.

At the termination of the session *examinations* are held, either by the School Committee or by the Board of Education, the City and Guilds of London Institute, or other established examining body.

An *annual exhibition* is held of the work done by students in the workshops, laboratories, etc., of the school.

In the library there is a "*Suggestion Book*," in which students are invited to enter any suggestion they may have to make in relation to the work of the school. Careful consideration is given to these by the Principal.

89. *Courses of Study, Evening Classes.*—The following are the evening courses, viz.:—

I. *The Courses in Chemistry* include a short and a general course in inorganic chemistry; organic chemistry, chemistry, chemistry of the carbon compounds; special courses for chemists and druggists of two years' duration;[1] chemistry for bakers and for brewers; senior course in chemical philosophy; senior course in quantitative analysis; special work in chemistry; crystallography and mineralogy.

The work is carried on by means of lectures and laboratory practice.

II. *Courses in Metallurgy.*—These courses include mining; preparatory, elementary, advanced, and senior courses in metallurgy; special courses in metallurgy for iron and steel workers, for brass and metal workers, for gold and silver workers; special course of twenty lectures in metallography for advanced metallurgy students; special advanced course in ores and minerals for metallurgy and mining students; the principles of mining; special course in electro-plating and deposition for electro-platers and gilders; special course in electro-plating and deposition for brass-workers and nickel-platers; advanced course in electro-plating and deposition; elementary and advanced courses in metal colouring and bronzing. A four years' course of theoretical and practical instruction is arranged for students who wish to make a special study of the nature of metals. Beginners take the *Preparatory Course*, which forms an introduction to the more specific branches of study, in conjunction with the *Elementary or Trade Course.* All the classes are arranged to meet the convenience of students engaged during the daytime.

III. *Course in Physics.*—The subjects of this course are: Elementary mathematics, including arithmetic, algebra, and geometry; mathematics (Stage II); advanced and senior mathematics; elementary and advanced stages in practical mathematics; special mathematics; junior and senior class for physics; junior and senior class for physical laboratory; preliminary course in electricity and physics; elementary, advanced, and senior courses in electricity; elementary and advanced courses in telegraphy and telephony; elementary, intermediate, and advanced courses in electrical engineering; senior classes in electrical engineering; design class for electrical engineering; electrical laboratories (junior, advanced, and senicr); three stages in electrical jointing and fitting.[2]

The classes in electricity are arranged so as to offer students the means of acquiring a good grasp of electrical science, together with a working knowledge of its application to the industries of telegraphy, telephony, electric lighting and distribution of power, and electrical engineering generally.

The conditions of evening work make it impossible for a student to take, in any one session, all the subjects which are desirable. He is therefore advised, at the commencement of the session, to consult the teachers of the Department, who consider his case individually, and recommend the classes most suitable.

IV. *Courses in Engineering.*—The courses comprise: Elementary, and advanced and Honours classes in practical geometry; preparatory classes in geometrical and mechanical drawing; elementary and advanced courses in machine construction and drawing; mechanical laboratory; elementary and advanced courses in steam; elementary and advanced courses in engineering laboratory; ordinary grade and senior course in mechanical engineering; special course of twelve lectures in graphical statics; special course in structural design; special course in indicator diagrams and valve gears; special course in the materials of engineering and processes of construction; special course of twelve lectures in hydraulic engineering; special course in gas and oil engines; surveying and levelling; pattern-making; fitting and turning; and special course of lectures for workshop students. A small portion of the work is done on Saturday afternoon. The Laboratory courses must always be taken in conjunction with the lectures.

Before commencing their studies, students consult the head of the department, who advises them regarding the classes most desirable for them to take. A regular course of study should precede attendance at the Special Courses.

V. *Building Trade Courses.*—These courses comprise the following: Elementary, advanced and honours courses in building construction; builders' quantities; preparatory, elementary, and advanced courses in carpentry and joinery; elementary and advanced drawing for carpenters and joiners; stair-casing and hand railing (workshop and drawing); drawing for bricklayers and masons; drawing for sanitary inspectors and plumbers; sanitary science; sanitary science for plumbers; masonry; elementary and advanced courses in plumbing.

VI. *Metal Trade Courses.*—These courses comprise: Brass-founding, with workshop practice and lectures on modelling, pattern making, chasing, casting, dressing, polishing, leaf-beating, dipping and bronzing, lacquering, mixing of metals; course for gas-fitters; geometry; special course for sheetmetal-workers; elementary and advanced course in sheetmetal work.

VII. *Miscellaneous Courses.*—These consist of botany; manual training in woodwork; typography; linotype machine; and farriery.

90.

[1] Wednesday afternoons. [2] The first stage of this course is given on Saturday afternoons.

90. *Day and Evening Courses for Women, Municipal Technical School, Birmingham.*—The same subjects are taught in both the day and evening classes. They consist of (*a*) cookery; (*b*) elementary and (*c*) advanced courses in dressmaking; and (*d*) laundry work. During the summer months there are special classes for (*e*) cookery and (*f*) dressmaking, also in (*g*) millinery and (*h*) needlework.

91. *Societies and Clubs, Municipal Technical School, Birmingham.*—These comprise the following: Societies formed of the union of teachers and students; debating and literary society; chemical society; "100 Books" Club (the "100 Best Books," selected by Sir John Lubbock); Photographic Society; Rambling Club; and the Engineering Society.

The Technical School Magazine is issued by the Union six times during the session. It contains school news, reports of school societies, and articles of scientific and general interest.

92. *Municipal School of Art, Birmingham.*—The Municipal School of Art of Birmingham comprises (1) the Central School, Margaret-street; (2) Victoria-street School for jewellers and silversmiths; (3) Moseley-road Branch School of Art; (4) Nine branch schools of art held at the Board Schools in (*a*) Clark-street, Ladywood; (*b*) Conway-road, Sparkbrook; (*c*) Cowper-street, New Town Row; (*d*) Dudley-road; (*e*) High-street, Harborne; (*f*) Highfield-road, Saltley; (*g*) Hope-street; (*h*) Jenkins-street, Small Heath; and (*i*) Norton-street. The chief purpose of the school is stated to be "to make workmen better workmen."

Courses of Study, Central School, Margaret-street.—The courses of instruction provided in the Central School are available to students from 10 a.m. to 4·30 p.m. daily, and in the evening from 7·15 to 9·15. The school year is of nine months' duration, and is divided into two terms, viz., an Autumn Term and a Winter Term. The fee for the complete course is £4 10s. per term, subject, however, to reduction in special cases. Lectures are delivered on the following subjects:—

(1) Geometrical drawing; (2) Perspective; (3) Practical, plane, and solid geometry; (4) Architecture; (5) Elementary and advanced architectural design; (6) Architectural history; (7) Wood-carving; (8) Metal-work and enamelling; (9) Stained glass work and figure design; (10) Book-binding; (11) Writing, illumination, and heraldic drawing; (12) Needlework; (13) History of art and historic ornament; and (14) Anatomy.

The subjects of study are divided into *Elementary* and *Advanced*, and are as follows:—

Elementary.

(*a*) Freehand by class lectures on black-board; memory drawing; flat tinting; drawing from geometric models, from objects, and from plants; memory drawing; elementary design, and history of art; modelling from cast; and modelled design.
(*b*) Shading from casts, etc.; plane and solid geometry; perspective, and its application to drawing interiors, landscapes, models, and decorative objects; elementary design; elementary painting of ornament; modelling from flat; and modelled design (elementary).
(*c*) Exercises in metal-work, wood-carving, etc., from approved examples.

Advanced.

(*d*) Advanced painting of ornament; painting single objects, plants, birds, etc.; composition of colour; decorative subjects.
(*e*) Drawing, painting, and modelling the human figure and animals from the cast and from life; anatomy.
(*f*) Advanced design, and figure composition—drawn, painted, and modelled, with technical instruction in the following processes, viz.:—metal-work; enamelling; stained glass work and figure design; book-binding; writing, illumination and heraldic drawing; embroidery and other needlework; wood-carving; stone-carving; drawing for book illustration; wood-engraving; terra cotta; die-sinking; encaustic painting; leather work; the making ef decorative cartoons, and working in fresco, gesso, tempera, oils, sgraffito, lithography, etc.

There is a special course for house-painters and decorators, an architectural course of four years' duration, a course in building construction, and one in practical, plane, and solid geometry.

93. *School for Jewellers and Silversmiths, Vittoria-street, Birmingham.*—The School for Jewellers and Silversmiths is open on three afternoons and five evenings a week. The session continues for nine months, and is divided into an Autumn Term and a Winter Term. The course of study consists of:—

(*a*) Elementary drawing; (*b*) Advanced drawing; (*c*) Design directly applied to the making of objects and their decoration; (*d*) Modelling; (*e*) the execution of work in the following processes, viz.:—carving, chasing, chipping, damascening, enamelling, engraving, mounting, raising, repoussé, and setting.

94. *Branch School of Art, Moseley-road, Birmingham.*—The classes of the Moseley-road Branch School also meet on three afternoons and five evenings a week. The course includes:—

(*a*) Freehand drawing; drawing from models; drawing on the black-board; memory drawing; light and shade from nature; casts and objects; geometrical drawing and perspective; drawing from the antique; design, painting, modelling, and modelled design; wood carving; (*b*) Building construction, and practical, plane, and solid geometry.

The Classes of the Branch Schools of Art of the Birmingham School meet on four evenings a week.

The course of instruction embraces:—

Freehand drawing; drawing from models; drawing on the black-board; memory drawing; light and shade from nature, casts, and objects; geometrical drawing and perspective; design, painting, modelling, and modelled design.

A *library* containing books on art and subjects cognate thereto is connected with the Birmingham School of Art.

Personal examinations and examination of works are held by the Government Board of Education. Local prizes, free admissions, and scholarships are awarded.

95. *The Leeds Institute of Science, Art, and Literature.*—The Leeds Institute of Science, Art, and Literature includes the following, viz.:—

(1) Technical School; (2) a School of Art; (3) the Boys' Modern School; (4) the Girls' Modern School; (5) the School of Music; (6) Commercial Evening School; (7) and Special Saturday Classes for Teachers.

In the first-mentioned the classes meet in the evening only; in the second there are day, evening, and special classes.

In the *Technical School of Leeds* there are seven courses of instruction provided, each being divided into two parts, viz., a junior course and a senior course. The first extends over three years, and is for *young boys*, the latter is of four years' duration, and is intended for those above the age of 16. Two subjects only are compulsory in each year's course, an optional subject being taken, if there be ample time for its study. Students are advised to attend the school two or three evenings a week. A student may enter at once on the second year's work in either course, provided that he can shew proof of sufficient knowledge of the first year's work, but only in rare cases is a student allowed to begin the third year's work without passing through the second year. Examinations are held by the Science and Art Department of the City and Guilds of London Institute. The University of London conducts examinations in certain subjects. So too do the Institute of Chemistry and Pharmaceutical Society.

Prizes are awarded by the school, by the Board of Education, South Kensington, and by the City and Guilds of London Institute. Scholarships are awarded by the Leeds City Council.

The composition fee for a systematic course is 3s. 6d. per session; if laboratory practice is included it is 5s. Higher fees are charged to students attending one class only.

96. *Courses of Study, Technical School, Leeds.*—The courses of study are as follows:—

I. *Courses in Mechanical Engineering*—

Junior Course.

For the first year, the obligatory subjects are: geometrical drawing; workshop arithmetic, or elementary practical mathematics; the optional subjects are: practical physics, or theoretical mechanics, or freehand and model drawing. For the second year the obligatory subjects are: practical, plane, and solid geometry, and elementary practical mathematics; the optional subjects being the same as for the first year. In the third year, the subjects studied are: practical, plane, and solid geometry and mathematics; the optional subjects are either the same as for the two preceding years or machine construction and drawing is taken.

Senior Course.

In the *Senior Course*, the obligatory subjects for the first year are: practical, plane, and solid geometry, or mathematics; machine construction and drawing; the optional subjects being mathematics, or practical, plane, and solid geometry, or practical mechanics. During the second year the obligatory subjects are: practical, plane, and solid geometry, or mathematics, or theoretical mechanics, or mathematics, or practical, plane, and solid geometry, or steam or applied mechanics, or practical mechanics; machine construction and drawing; the optional subjects being one of the following, viz.: theoretical mechanics, mathematics, practical, plane, and solid geometry, steam or applied mechanics, or practical mechanics. For the third year the obligatory subjects are: applied mechanics, or steam and the steam engine, or mechanical engineering, or the optional subjects of the preceding year; machine construction and drawing, or the optional subjects of the second year. The optional subject may be taken from one of the following: theoretical mechanics, mechanical engineering, steam, applied mechanics, or practical mechanics. During the fourth year, the subjects for study are: theoretical and practical chemistry, or metallurgy, or any stages not already taken of the subjects mentioned for previous years; optional subject, any one of the aforementioned for this year.

II. *Courses in Electrical Engineering*—

Junior Course.

The course is identical with that of the junior course for mechanical engineering, except that one of the options for the third year is magnetism and electricity.

Senior Course.

1*st Year.*—Practical plane and solid geometry, or mathematics; machine construction and drawing. *Optional:* One of the following:—Mathematics, practical plane and solid geometry, theoretical mechanics, magnetism and electricity.

2*nd Year.*—One of the following:—Practical plane and solid geometry, mathematics, machine construction and drawing, or theoretical mechanics; and magnetism and electricity. *Optional:* One of the following:—Theoretical mechanics, mathematics, practical plane and solid geometry, practical physics (electricity), chemistry.

3*rd Year.*—(*a*) Mathematics, or theoretical mechanics, or applied mechanics; (*b*) Magnetism and electricity. *Optional:* One of the following:—Telegraphy and telephony, practical physics (electricity), chemistry, electric light and power.

4*th Year.*—Any stages not yet taken of the abovenamed subjects, or chemistry, or metallurgy (only for students already possessing a good knowledge of chemistry). *Optional:* Any one of the preceding subjects.

III.

III. *Courses in Mining*—

Junior Course.

1*st Year.*—Geometrical drawing; workshop arithmetic, or elementary practical mathematics. *Optional:* Practical physics, or freehand and model drawing.
2*nd Year.*—Practical plane and solid geometry, elementary practical mathematics. *Optional:* As for first year.
3*rd Year.*—Practical plane and solid geometry, or machine construction and drawing, or chemistry; geology. *Optional:* As for 1st year, or chemistry, or machine construction and drawing, or practical plane and solid geometry.

Senior Course.

1*st Year.*—One of the following:—(*a*) Chemistry, geology, machine construction and drawing, mathematics; and (*b*) Mining, or steam and the steam-engine. *Optional:* Any one of the foregoing subjects for this year, *or* (for students intending to take mine surveying later), practical plane and solid geometry.
2*nd Year.*—Same as 1st year both in obligatory and optional subjects.
3*rd Year.*—(*a*) Mathematics, or theoretical mechanics, or applied mechanics, or practical plane and solid geometry; (*b*) Mining. *Optional:* As for 1st year or mine surveying.
4*th Year.*—Mine surveying, or any stages not yet taken of the abovenamed subjects. *Optional:* Mine surveying or metallurgy, etc.

IV. *Courses in Plumbing*—

Junior Course.

1*st Year.*—(*a*) Geometrical drawing; (*b*) Workshop arithmetic. *Optional:* Freehand and model drawing.
2*nd Year.*—(*a*) Practical plane and solid geometry; (*b*) Elementary practical mathematics. *Optional:* As for 1st year, or practical physics.
3*rd Year.*—(*a*) Practical plane and solid geometry, or chemistry; (*b*) mathematics [either *elementary practical mathematics*, viz, arithmetic, algebra, mensuration, graphic methods (use of squared paper), and geometry *or* elementary arithmetic, algebra, and geometry]. *Optional:* Practical physics, or building construction.

Senior Course.

1*st Year.*—(*a*) Practical plane and solid geometry, or mathematics (as above); (*b*) Building construction, or theoretical mechanics, or practical physics, or chemistry. *Optional:* Preliminary science course for plumbers, or plumbers' work (theory only).
2*nd Year.*—(*a*) As for 1st year, or theoretical mechanics; (*b*) As for 1st year. *Optional:* Plumbers' work (but no practical work unless over 18).
3*rd Year.*—(*a*) Either (*a*) or (*b*) of 1st year's work; (*b*) Plumbers' work. *Optional:* Either (*a*) or (*b*) of 1st year's work.
4*th Year.*—Advanced stages of abovenamed subjects. *Optional:* Free choice.

V. *Courses in Chemical Industries*—

Junior Course.

1*st Year.*—(*a*) Workshop arithmetic; (*b*) Freehand and model drawing *or* geometrical drawing. *Optional subject:* Practical physics.
2*nd Year.*—(*a*) Mathematics; (*b*) Magnetism and electricity. *Optional subject:* Practical physics.
3*rd Year.*—(*a*) Mathematics or practical physics; (*b*) inorganic chemistry. *Optional:* Magnetism and electricity, or practical physics.

Senior Course.

1*st Year.*—(*a*) Inorganic chemistry (theoretical); (*b*) inorganic chemistry (practical). *Optional:* Mathematics or practical physics.
2*nd Year.*—As for 1st year. *Optional:* Organic chemistry or elementary metallurgy.
3*rd Year.*—(*a*) Theoretical and practical work in inorganic or organic chemistry; (*b*) theoretical and practical work in inorganic or organic chemistry or metallurgy, or gas manufacture, or oils and fats, or iron and steel manufacture. *Optional:* Any one subject under (*b*)

VI. *Pharmaceutical Chemistry.*—This course is for senior students only.

1*st Year.*—(*a*) Elementary inorganic chemistry (theoretical); (*b*) elementary inorganic chemistry (practical). *Optional:* Practical physics or mathematics.
2*nd Year.*—(*a*) Advanced inorganic chemistry (theoretical); (*b*) advanced inorganic chemistry (practical). If unsuccessful in the 1st year's examination, elementary, theoretical, and practical inorganic chemistry to be taken again instead of advanced inorganic chemistry with practical physics or mathematics, or botany as optional subject.
3*rd Year.*—(*a*) Elementary organic chemistry (theoretical); (*b*) elementary organic chemistry (practical). *Optional subject:* Botany, but if advanced chemistry is not passed in at the end of the second year, it is taken again and also elementary organic chemistry instead, with botany as an optional subject. Advanced inorganic chemistry (theoretical and practical) is taken by those who in their second year took elementary inorganic chemistry.
4*th Year.*—The subjects necessary for the completion of the course.

VII. *Courses in Building Trades*:—

Junior Course.

1*st Year.*—(*a*) Geometrical drawing; (*b*) workshop arithmetic or mathematics *Optional:* Practical physics, or theoretical mechanics, or freehand and model drawing.
2*nd Year.*—(*a*) Practical plane and solid geometry; (*b*) mathematics. *Optional:* Same as for 1st year.

Senior

Senior Course.

1*st Year.*—(*a*) Practical plane and solid geometry or mathematics; (*b*) building construction. *Optional:* Mathematics, or brickwork, or masonry, or carpentry and joinery, or practical woodwork.

2*nd Year.*—(*a*) Building construction; (*b*) practical plane and solid geometry, or theoretical mechanics, or applied mechanics, or one of the following: brickwork, masonry, carpentry and joinery. An optional subject may be taken from any of these.

3*rd Year.*—Same subjects as for 2nd year.

4*th Year.*—Architecture, or quantity surveying, or any stages not already taken of subjects above-mentioned. *Optional:* Hygiene, or practical sanitation, or as desirable.

There is a special course in chemistry and domestic science for teachers of cookery. Other subjects in which instruction is given in the school, are typography, photography, and tailors' cutting.

97. *School of Art, Leeds.*—The aim of the school, according to the calendar, is "to impart by a systematic course of instruction a knowledge of the principles and practice of art, with a view to its application by manufacturers, designers, craftsmen, and all intending to make art a profession; to form a sound and comprehensive basis for the study of its pictorial and decorative branches; and to instruct those who desire to make a knowledge of art a part of their general education." As before stated, for instruction in this subject there are day, evening, and special classes.

Courses of study, School of Art.—The following are the courses of study:—

(1) geometry; (2) perspective; (3) freehand and model drawing; (4) time and memory drawing; (5) architectural drawing and design; (6) drawing and shading with chalk, pen, or brush; (7) painting in oil and water colours; (8) drawing and painting the figure from the antique and from life; (9) modelling in wax, clay, and plaster; (10) casting in metals; (11) designing for all industrial and decorative art; (12) wood-carving; (13) building construction; (14) quantity surveying; (15) book-binding; (16) embroidery; (17) gesso work; (18) repoussé work; (19) enamels; (20) preparation for teachers certificates and for the examination of the Royal Institute of British Architects.

The syllabus of classes comprises anatomy, historical and practical architecture, historical architecture, architectural design, building construction and drawing, drawing from life, drawing on the blackboard, model drawing, drawing in light and shade from a cast, freehand drawing in outline, memory drawing of plant form, modelling the head from the life, painting ornament, principles of ornament, historic ornament, geometrical drawing, perspective, bookbinding, quantity surveying, wood-carving, drawing from the antique, drawing the antique from memory, painting from still life, modelling from the antique, modelling the head from life, modelling from life, modelling design. There are evening continuation schools for drawing and design for West Riding teachers.

98. *The Boys' Modern School, Leeds.*—Reference to the Boys' Modern School is instructive. The subjects of instruction comprise the following, viz.:—

Scripture (from instruction in which boys whose parents wish it are exempt), English, grammar, composition, and literature, English history, geography (physical, political, and commercial), arithmetic, book-keeping, commercial correspondence, algebra, Euclid, and higher mathematics, Latin, French, German, chemistry, and physical science (including theoretical and applied mechanics), drawing (freehand, model, geometrical, and mechanical), and vocal music. German is taught in the upper forms as an alternative to Latin.

Boys are prepared for the examinations of the Board of Education, for the University and College of Preceptors' Local Examinations, and, when required, for the Preliminary Pharmaceutical, Medical, and Legal Examinations, for Scholarships at the Yorkshire College, Public Schools, and elsewhere, and for the Civil Service.

99. *The Girls' Modern School, Leeds.*—The curriculum of this school is arranged in accordance with the annual syllabus, published by the University of Oxford, for the regulation of the examinations for girls. Pupils in the upper forms are prepared for the South Kensington Science and Art Examinations, the London University Matriculation Examination, and for the Oxford Local Examinations. The subjects taught are mainly mathematics, English language and literature, arithmetic, geography, history, Latin, French, chemistry, natural science, drawing, vocal music, physical exercise and drill, needlework, and dancing. In connection with the school, there is also a Kindergarten division.

100. *The School of Music, Leeds*—Solo singing, pianoforte, organ, violin, violoncello, and flute playing, harmony and counterpoint, rudiments of music form the subjects of instruction of the Leeds School of Music.

Besides the above, there is a *Commercial Evening School,* the classes being held at the Central Higher Grade Board School at Woodhouse-lane, Leeds, and there are also *Special Saturday Classes for Teachers* in commercial subjects.

101. *The Glasgow and West of Scotland Technical College.*—The Glasgow and West of Scotland Technical College was organised in 1886, its title being the outcome of the amalgamation of Anderson's College, the Young Chair of Technical Chemistry (in connection with that college), the College of Science and Arts, Allen Glen's Institution, and the Atkinson Institution. Its main object is stated to be to afford a "suitable education to those who wish to qualify themselves for following an industrial profession or trade, and to train teachers for technical schools." The work of each of these institutions is distinct. For the operations of the work of the College day and evening classes have been formed.

The

The *Day Classes* of the College have the following courses, viz.:—

(1) Civil engineering; (2) Mechanical engineering; (3) Naval architecture; (4) Electrical engineering; (5) Architecture; (6) Chemical engineering; (7) Metallurgy; (8) Mining engineering; (9) Mathematics and physics; and (10) Chemistry.

Of these courses separate subjects may be taken, or a complete course of three years' duration leading to the diploma of the College. Candidates for the diploma and students under 16 years of age, must pass an entrance examination in (1) English, (2) Mathematics, and (3) in Freehand drawing. A fourth subject, viz., Latin, or a modern language, must be passed by the former, before admission to the final examination. Students in Engineering, after gaining the diploma of the College, may also compete for the B.Sc. degree in Engineering Science of the University of Glasgow, after an attendance of a least one academical year at that University, and passing the University preliminary examination; or they may enter for the B.Sc degree of the University of Edinburgh after an attendance of two years at the College and one year at the University. Students of the College who intend to graduate in Science at the Glasgow University may have their fees paid out of the *Carnegie Trust for the Universities of Scotland,* under certain conditions.

102. *The Municipal Technical Institute, Belfast, Ireland.*—The chief aim of this institution is to provide instruction in the principles of those arts and sciences which bear directly or indirectly upon the trades and industries, especially of Ireland, and to experimentally shew how their advancement may be promoted by an application of these principles.

The Institute is fitted with laboratories for physics chemistry, electrical engineering, mechanics, and with workshops for spinning and weaving, wood-carving, plumbing, house painting, decoration, and plastering.

The *courses of study* are as follows:—

I. *Preparatory course*, the subjects of which are *English* of a commercial nature, arithmetic and mensuration, elementary drawing, elementary science.

II. *Course in Mathematics:* including practical mathematics (arithmetic, algebra, mensuration, and geometry), pure mathematics (arithmetic, algebra, geometry, and plane trigonometry), trigonometry, for surveyors, solid geometry, spherical trigonometry, geometrical conics, co-ordinate geometry, differential calculus, and integral calculus.

III. *Course in Mechanical Engineering.*—In this course instruction is given in geometrical drawing; practical plane and solid geometry, which has an elementary, an advanced, and an honours stage; machine construction and drawing, with two stages, viz., elementary and advanced; applied mechanics, with two stages; *mechanical laboratory*, with a complete equipment of experimental apparatus, the object aimed at in the work being the obtaining accurate quantitative results. Steam and the steam-engine; marine engineering, in which, in the elementary stage, students are taught to make neat hand-sketches of simple details of the steam-engine from the blackboard. A feature of the advanced stage, also, is hand-sketching, with notes on the properties and strength of materials used in engine and boiler construction.

IV. *Course in Naval Architecture.*—This course, in its elementary stages, is intended for junior draughtsmen, ships' fitters, and those engaged in the shipbuilding trades. It includes practical work, theoretical work, and drawing. In its advanced stage, the building of merchant vessels, Admiralty vessels; laying-off; theory; drawing and designing.

V. *Course in Physics and Electrical Engineering.*—The subjects studied under the heading of *Physics*, are sound, light, and heat (elementary course); laboratory work in the same: magnetism and electricity, with an elementary stage dealing with magnetism, frictional and voltaic electricity, and laboratory work; and an advanced stage dealing with magnetism, electro-statics, current electricity, thermo-electricity, and laboratory work on magnetism, voltaic electricity, and electro-statics.

The course in *Electrical Engineering* consists of electric lighting and power distribution, in the *preliminary grade* of which instruction is given in fundamental mechanical units, the fundamental electrical units, primary and secondary batteries, electric bells, fundamental effects of the electrical circuit, electrical measurements, the incandescent and arc lamps, classification of dynamos, the electro-motor, short sketch of thermo-electricity, insulators and conductors, systems of wiring houses, and the elementary consideration of the distribution of electrical energy. In the ordinary grade the work is of a much higher character. Laboratory work is given in each.

VI. *Course in Architecture and Builders' Work.*—The subjects included in this course are building construction and drawing; builders' quantities; carpentery and joinery (drawing and lecture course); plasterers' work; painters' and decorators' work (lecture and practical course); stone-cutting (lecture and drawing course); wood-carving for furniture and architectural decoration; land and engineering surveying and levelling—this last including chain surveying, levelling, office work, and surveying with angular instruments.

VII. *Course in Sanitary Engineering—Plumbing.*—There are lecture and drawing courses, the first treating, in the preliminary grade, of workshop arithmetic, geometry, and drawing; (2) elementary physics for plumbers; (3) alloys, solders, etc.; (4) workshop appliances and the principles of their action; (5) tools used in plumbing. In the ordinary grade they consist of: Properties and uses of materials used in plumbers' work; elementary science for plumbers; external roof work; hot-water apparatus; sanitary appliances in common use and the principles of their action; mechanical appliances and the principles of their action; drainage. In the latter, instruction is given in the methods of obtaining measurements; simple calculations of areas and contents; simple examples of estimating cost of work; simple examples of obtaining measurements from plans; geometry and the preparation of working drawings to scale; explanation of various plans and sections; elementary instruction in the preparation of detail drawings, plans, and sections, for the preliminary grade; in the ordinary grade the instruction is based on the lectures, and adapted to the needs of students. There is also a course in sanitary science and honours-grade plumbing, and one in practical plumbers' work for preliminary, ordinary, and honours-grades.

VIII. *Course in Textile Industries.*—This course includes flax-spinning and weaving. After each lecture an exercise class is held in which the calculations occurring in connection with the operation of spinning are fully explained and exemplified. Opportunity of examining and working the weaving looms of the school is afforded the students, so as to give practical facility.

IX. *Course in Pure and Applied Chemistry.*—The instruction given in this course treats of: The elements of chemistry; inorganic chemistry; organic chemistry; practical chemistry; special work in chemistry. In the *pharmaceutical section* of the course the subjects considered are: General and pharmaceutical chemistry; practical chemistry; botany; materia medica; pharmacy (theoretical and practical); and materia medica and pharmacy for druggists. photography, the bleaching, dyeing, and printing of cotton, linen, and other vegetable fibres, and bread-making, form also part of the course in chemistry.

X. *Course in Printing.*—The subjects of instruction are typography (lectures fully illustrated by samples of letter-press); machine and press work (including its early history, etc.); lithography (the lectures are made as practical as possible, examples of various kinds of work being used to illustrate the instruction); and bookbinding.

XI. *Course in Miscellaneous Trades and Industries.*—This includes instruction in the manufacture of boots and shoes; in bread-making; in cake ornamentation for bakers; in road-carriage building (lecture and drawing course); in watch and clock-making; in sheet-metal work; and in tailors' cutting.

XII. *Course in Natural Science.*—The subjects taught in this course are botany; geology; physiology; and hygiene.

XIII. *Course in Commerce.*—The instruction of this course embraces: Commercial English and arithmetic; shorthand (Pitman's system); book-keeping (beginners' class); book-keeping and commercial accounts; commercial law and economics and an elementary and advanced course in modern languages (French, German, and Spanish).

These are all evening courses, with the exception of one, which is given on a Saturday afternoon.

XIV. *Courses in Women's Work.*—These courses are both day and evening, and are as follows:—Cookery; laundry work; dressmaking; millinery; lace-making; embroidery and needlework and blouse and under-skirt making. The first five subjects are taught both during the day and in the evening. Instruction in embroidery and art needlework is given in the day time only, and blouse and under-skirt making in the evening. To each subject not more than two hours a week are devoted, but to each department of lace-making, viz., Carrickmacross lace (appliqué and guipure), point lace, Limerick lace, Honiton (or pillow) lace, Irish crochet lace, two hours per week each are devoted. There are two centres where women's work is carried on, viz., at College Square North and Templemore Avenue Baths. The instruction in each branch is essentially practical, and demonstrations are given in cooking. The instruction in dressmaking is based upon the Cosmopolitan or Chart System, and includes a course for students desirous of obtaining the certificate of the City and Guilds of London Institute.

All the above-mentioned courses are suitable for those already engaged during the day in handicrafts or business who desire to supplement and develope their present knowledge and the experience gained in the workshop, warehouse, etc. They are valuable for apprentices, journeymen, and others employed in the various industries in the city and district. Before entering upon these courses, an elementary knowledge of mathematics and drawing should be acquired for they are an essential to success. Not more than two hours a week is devoted to each individual subject.

103. *School of Art, Municipal Technical Institute, Belfast.*—The aim of the school is to give, by carefully-arranged and varied courses of study, a thoroughly practical knowledge of design, painting, drawing, and modelling, especially in their application to the various technical processes of manufacture and handicrafts, and in their relation to architecture, so as to furnish useful training to those intending to work as architects, designers, and craftsmen, and to assist those who wish to follow up design in its bearing upon pictorial composition, such as book decoration, book illustration, and wall-posters. Its purpose also is *to assist those desirous of making art a part of their general education*, and to spread a knowledge of art and the appreciation of art work; also to give facilities to those wishing to follow art as a profession, or to include it in their general qualifications as teachers in Public, National, Art, or other Schools.

There are spacious and well-lighted rooms for the study of the living model and the antique, also rooms for modelling in clay, for design in relation to manufactures and handicrafts, and for still-life and flower-painting. There are special work-rooms for various handicrafts and art industries, so that students can see some of the processes for which they are designing, and have the opportunity of working out their own designs. There are morning, afternoon, and evening classes. The morning and afternoon classes continue for three hours each, and the evening classes for two hours on Monday, Tuesday, Wednesday, Thursday, and Friday. There is also a Saturday morning class of three hours' duration for teachers. The works of students of an advanced character may be sent annually to South Kensington for examination. A reference library and a museum, consisting of objects and illustrations shewing the methods and processes in use in modern applied and decorative art, are at the disposal of the students.

The *Courses of Study* are as follows:—

I. *Elementary or General*, the instruction consisting of—

(i) Freehand drawing of ornament and plant from copy and cast, viz.: (1) simple brush-work; (2) principles of ornament; and (3) design.
(ii) Model drawing, and the drawing and shading of common objects.
(iii) Geometrical drawing, and its application in art work. Perspective (elementary), and its application in art work.
(iv) Drawing in light and shade from cast.
(v) Elementary plant-drawing from actual plants and flowers; decorative applications; memory drawing of plant form.
(vi) Elementary modelling in clay.

II.

II. *Drawing, Painting, and Figure Composition.*—This course includes: Preparatory drawing from antique and life. Artistic anatomy and proportions of the human figure. Painting in oil and water-colour from flowers, fruit, and natural objects. Drawing and painting from the cast, details, antique bust, and figure-drapery arranged on the antique. Drawing and painting from the head and full-length living model Drawing and painting from drapery arranged on the living model; also costume study on the living model. Figure painting for decorative composition. Memory studies and time studies of the figure. Composition of figures for pictorial and decorative treatment. Outdoor painting from nature.

III. *Design.*—In this course attention is given to the principles of ornament and elementary design; the historic styles of ornament in relation to design; the study of lettering and of fine examples of ancient and modern craftsmanship from photographs and actual specimens; drawing and painting of flowers, foliage, and natural objects from the structural point of view; design (advanced). The technique of design and colour for various materials and processes; figure composition and the use of the figure in ornament; design applied to handicrafts; painting of ornament in a decorative manner.

IV. *Architecture.*—This course has three divisions, viz., Junior, Intermediate, and Senior, and form a preparation for students entering the architectural profession. In the *Junior Division,* the instruction consists of elementary drawing from ornament, models, etc., and design; of lectures on historic architecture, with exercises in architectural drawing and additional notes made by the student; also sketching and measuring from casts of Classic and Gothic architecture, from photos., and from existing buildings; elementary perspective for architects; elementary building construction; drawing in light and shade; and drawing from the antique. In the *Intermediate Division,* the subjects of study are:—Architectural sketching and measuring from existing buildings; advanced design of objects, with construction and decoration in connection with architecture, or modelling in relation to architecture; the study of the figure and ornament in architecture; note-book sketches of historical architecture; drawing from the antique figure or cast of architectural detail in preparation for life-drawing. In the *Senior Division,* instruction is given in architectural design, complete work carried on through the whole of the session and advanced drawing or modelling.

V. *Modelling.*—This course embraces: *Modelling antique:* details, bust, figure in the round and in relief, also drapery on the antique. *Modelling from life:* details, bust, figure in the round and in relief, drapery arranged on the life. *Modelling Design* for various processes: elementary and advanced. *Figure composition* in relief and in the round. *Casting in Plaster* from models in clay or wax.

VI. *Art Industries and Handicrafts.*—These consist of Art needlework and embroidery; wood-carving; book-binding; enamelling on metal; metal work—repoussé and hammered; stained glass; lace-making, including Carrickmacross (appliqué and guipure), point lace, Limerick, Irish crochet, Honiton or pillow lace; Mosaic work.

VII. *Courses for Teachers.*—These courses include freehand drawing, elementary design and brush-work, model drawing and the drawing and shading of common objects. geometrical drawing, perspective, light and shade, elementary modelling, blackboard drawing, plant and nature study and methods of teaching.

104. *Conclusion.*—The preceding particulars of the various grades of technical education in the United Kingdom are merely typical, and do not aim at giving an exhaustive description. Probably sufficient has been adduced to give an indication of the range and character of the various grades of technical education extant. It may be added that a striking feature is the rapidity with which the equipments are being added to and the excellence of many of the recent editions. This is due to an awakening as to the national significance of a good system of technical education; and when the primary and secondary education of the United Kingdom are more thoroughly organised and perfected they will bring forth the results which may be expected from so elaborate and striking a development.

At the present time, the technical high schools or the university courses in technological subjects labour under the disadvantage that students at the time of entrance have not been thoroughly prepared. The splendid secondary schools of Europe, through which students pass prior to entry on the advanced technical courses, confer a preparation for technology, the value of which can hardly be overestimated, and this fact is appreciated by large numbers of English educational experts.

The extension of kindergarten work, the rapid introduction of Sloyd or other forms of manual training in the primary schools, the intensification of the demand for thoroughness of preparation for entry on all courses, the raising of the qualification of the teaching staffs, the variety of the courses, the increasing efficiency of the apparatus and mechanical equipment for teaching, bid fair to make technical education in the United Kingdom progress by leaps and bounds, but its full effect will not be seen until the primary and secondary systems have been thoroughly organised.

CHAPTER XL.

CHAPTER XL.

Agricultural Education in Germany.

[G. H. KNIBBS.]

PART I.—SUPERIOR AGRICULTURAL EDUCATION.

1. *Agricultural Education in Germany—General.*—Technical instruction in Germany has, among other things, taken account of the necessities of agriculture and agricultural industries, and agricultural instruction is being steadily developed and brought to a high degree of excellence. It had its origin with a Dr. Thaer, at the beginning of the 19th century, who specially studied, not only German, but also other agricultural literature—a literature which even then was beginning to assume considerable dimensions.

The researches of René Réaumur in France,[1] Bergmann in Germany,[2] Wallerius in Sweden, Home in England, and of Priestley, Jan Ingenhausz,[3] Jean Senebier,[4] and Nicolas de Saussure,[5] revealed the significance of chemistry for agriculture. A knowledge of the superior methods of agriculture then existing in the United Kingdom, and *an appreciation of the meaning of chemistry for agriculture*, enabled Thaer to greatly improve the instruction on the subject in Germany. In 1802, he converted his property at Celle—about 26½ miles north-easterly from Hanover—into an experimental farm, with an establishment for agricultural instruction on a scientific basis. In 1804, the Prussian Minister, Hardenberg, induced Thaer to move to Möglin, where the foundations may be said to have been laid of a sound system of agricultural instruction, and of rational agriculture for the German Empire.

Between 1802 and 1858 no less than eleven farming institutions of a similar kind were established, viz., those in the table hereunder:—

Celle, 1802.	Jena, 1826.	Poppelsdorf, 1847.
Hohenheim,[6] 1818.	Tharandt,[7] 1829.	Weende, 1851.
Idstein,[7] 1818.	Eldena, 1835.	Waldau, 1858.
Schleissheim, 1818.	Regenswalde, 1842.	....

Of the above, only Poppelsdorf and Hohenheim remain, these having now been made agricultural high schools. The creation of agricultural institutes at the Universities of Berlin, Halle, Göttingen, Giessen, Kiel, Leipzig, Breslau, Königsberg, and at the Polytechnicum of München, rendered the remaining nine superfluous, and they have disappeared. In 1881, the agricultural institute at the University of Berlin was created an independent High School of Agriculture.

There are four different categories of advanced agricultural instruction, one of secondary agriculture instruction, and five of elementary. These are as follows:—

Advanced—1. Independent agricultural high schools.
2. Agricultural institutes connected with the universities.
3. General higher agricultural institutes.
4. Special advanced lecture courses for proprietors, managers, and farmers of large estates.

Secondary—1. Secondary agricultural schools.

Elementary—1. Farming schools.
2. Agricultural winter schools.
3. Special lower agricultural schools.
4. Rural improvement schools.
5. Special elementary courses of lectures.
6. Agricultural education in elementary schools.

In regard to the higher grade of agricultural education, there is a difference of opinion as to whether the course at an independent agricultural high school, with its opportunities for practical work, or the course at an agricultural institute in a University, with opportunities for higher general education and more thorough instruction in agricultural science and general technology, is the better.

The

[1] [1683-1757.] [2] [1735-1784.] [3] [1730-1799.] Experiments on Plants, 1779. [4] [1742-1809.] Physiologie végétale. [5] [1767-1845.] Recherches chimiques sur la végétation, 1804. [6] 7 miles from Stuttgart. [7] 28 miles north-westerly from Frankfort on the Main. [8] 8½ miles from Dresden, south-westerly. There is a Forst-Akademie here.

The main objects of education at an agricultural high school are as follows:—

(1) The instruction of future proprietors, larger tenants, farmers, managers, etc., in all branches of theoretical and practical agricultural science.

(2) The theoretical and practical instruction of professors, lecturers, and other teachers of agricultural subjects.

(3) Theoretical and practical instruction in surveying and agricultural civil engineering.

(4) The training of future State officials.

(5) Scientific research for the furtherance of agricultural progress and agricultural knowledge.

The length of the courses ranges from four to six semesters, *i.e.*, from two to three years. Students attending less than the whole course receive certificates of having passed the examinations at the conclusion of each semester. Those who complete the three years' course may enter for the examination for the diploma of agricultural technical science, while those who desire to qualify for the positions on the staff of agricultural schools pass a still more difficult examination.

The standard of preliminary educational qualification demanded of agricultural students is in general lower than that of students at the Polytechnica and the schools of Mining and Forestry, it being considered that the shortening of the valuable period of practical agricultural work—deemed necessary before commencing the theoretical studies—would be unwise.

Those who wish to qualify for the teaching staff of agricultural schools, and also students of surveying[1] and agricultural (civil) engineering[2], must produce certificates, shewing that they have passed through the classical gymnasium, the Realgymnasium, or the Oberrealschule, although others may enter as extraordinary students or students not fully qualified. Students in these higher institutions must be at least 18 years of age, and have been engaged in practical agricultural or surveying work for, at least, from one to two years.

2. *The Agricultural High School of Hohenheim.*—This school, about 7 miles from Stuttgart, was founded as early as 1717 as a farming academy, and in 1865 was placed under the direct supervision of the educational department of Württemberg with the rank of a high school. It is managed by a director and a professorial council, including the principal professors and higher officials of the school, and has a considerable teaching staff, viz., those who give instruction in the following subjects:—

Professors.	
Agriculture	3
Physics, meteorology	1
Inorganic and agricultural chemistry	1
Organic and technical chemistry	1
Geology and mineralogy	1
Botany and plant physiology	1
Political economy	1
Veterinary science	1
Total	10

Assistant Professors.	
Zoology	1
Law	1
Building construction	1
Forestry	1
Bacteriology	1
Elementary surgery and ambulance	1
Minor agricultural subjects	1
Fruit, grape, and vegetable culture	1
Practical agriculture	1
Apiaries	1
Total	10

In addition to these the school has assistants, demonstrators, etc., in the following subjects, viz.:—

Chemistry	1	
Seed-testing	1	
Chemical technology	2	
Physiology	1	
Agricultural chemistry	1	
Veterinary medicine, etc.	1	
Total	7	
Grand total		27

The following is a synopsis of its scheme of instruction:—

1st Year.

Winter Semester I.	Hrs. p. wk.
Experimental physics	5
Inorganic experimental chemistry	4
Geology (I)	4
Introduction to botany	1
General zoology	2
National economy	4
History and literature of agriculture	1
Management of Hohenheim Estate	1
Total	22

Summer Semester II.	Hrs. pr. wk.
Meteorology and climatology	2
Application electricity to agriculture	1
Organic experimental chemistry	3
Geology (II)	4
Special botany	5
Special zoology	2
Special national economy	4
Management of Hohenheim Estate	1
Total	22

2nd

[1] Vermessungskunde. Kulturingenieurfach.

2nd Year.

Winter Semester III.	Hrs. p. wk.
Crops (general), clearing, cultivating, drainage, agricultural machinery	6
Principles of animal-breeding	2
Plant anatomy and physiology	4
Animal anatomy and physiology	4
Veterinary obstetrics	3
Management of estate	1
Total	20

Summer Semester IV.	Hrs. p. wk.
Crops (special)	3
Meadow and grazing land cultivation	1
Horse-breeding	3
Cattle-breeding	2
Pig-breeding	1
Poultry and fish breeding	1
Agricultural chemistry and fodder	5
Introd. technology	1
Agricultural building construction	2
Management of estate	1
Total	20

3rd Year.

Winter Semester V.	Hrs. p. wk.
Dairying	1
Agricultural management	5
„ book-keeping	2
Law (I)	2
Forestry (I)	3
Agricultural technology—	
Fermentation processes	3
Sugar manufacture	2
Ambulance instruction	1
Management of Hohenheim Estate	1
Total	20

Summer Semester VI.	Hrs. p. wk.
Fruit and vegetable culture	2
Agricultural valuations	3
Law (II)	2
Forestry	3
Geodesy (practical surveying and levelling)	2
Agriculture	1
Viticulture	1
Tobacco culture	1
Field and garden crops	1
Seeds	2
Diseases of domestic animals	2
Contagious diseases of animals	1
Management of estate	1
Total	22

An excellent feature in the system of lecturing, and one which is characteristic also in American lecture rooms, is the conversational element. The set lecture is often abandoned for a conversational type of lecture, in which every student is encouraged to ask questions.

3. *The Equipment of the Hohenheim Agricultural School.*—The *Agricultural Estate* attached to the school is about 800 acres, and the forest about 6,500 acres. The general equipment is as follows:—

(1) Fields for agricultural experiments.

(2) A vineyard.

(3) An orchard.

(4) Botanical garden and collections.

(5) Vegetable garden, etc.

(6) Dairies, including demonstration-dairy; breeding establishments (horses, cattle, sheep, pigs, poultry, fish, bees); stables.

(7) *Agricultural technological institution* with experimental stations for (a) Fermentation processes; (b) Testing dairy produce; (c) Distilling; (d) Brewing.

(8) *Laboratories* for (a) Chemistry; (b) Chemical-technology; (c) Seed-testing; (d) Physics, etc.; (e) Mathematical-physical department.

(9) *Experimental Stations, etc.*—(a) Agricultural chemistry; (b) Meteorology; (c) Machine-testing.

(10) *Museums* for (a) Mineralogy; (b) Zoology; (c) Veterinary collection; (d) Soils, manures, agricultural products, wools, etc.; (e) Forestry collections; (f) Miscellaneous collections; (g) Agricultural models; (h) Veterinary collections.

(11) *Library.*—(About 800 volumes).

The work at the agricultural experimental station is of a thoroughly practical character. The following represents the activity for the year 1900:—

(i) Chemical investigation of artificial fertilisers, fodder, soils, etc. (2,910 samples), determination of constituents, purity, market value.

(ii) Reply to 3,627 letters of inquiry, or asking for advice.

(iii) Investigation of 29 samples of soils forwarded by farmers, with inquiry as to manuring with—(a) phosphates, (b) lime, (c) potassium salts, (d) nitrogenous compounds.

(iv) Investigation of phosphoric acid values, examination of molasses, hops, etc.

At the seed-testing laboratory the work done was:—

(i) Testing 1,458 samples seeds (about one-third from foreign countries),

(ii) 1,324 reports and letters of advice, with other correspondence,

4. *The Farming and Gardening Schools at Hohenheim.*—The course of instruction in the farming school, extending over three years, embraces the following subjects, viz. :—

Arithmetic.	Physics.	Agriculture.
Drawing.	Chemistry.	Fruit-culture.
Geometry.	Surveying.	Treatment of animals.
German composition.	Drainage, irrigation.	Bee-keeping.

In the gardening school it embraces :—

Arithmetic.	Botany.	Vegetables and hot-house plants.
Writing and composition.	Vegetable anatomy and physiology.	Viticulture.
Drawing.	Microscopy.	Landscape gardening.
Geometry.	Horticulture.	Fruit-sorting.
Physics.	Fruit-culture.	Nurseries.
Chemistry.	General gardening.	
Surveying.		

This school gives lectures on fruit and vegetable growing in country districts, and answers letters of inquiry.

It may be mentioned that at the State seed depôt and nursery, the sale in 1900 was 62 tons of seeds and 4,449 trees.

Station for testing Agricultural Machines.—Agricultural machines and tools are tested. For example, fourteen were tested in 1900, expert opinion being given on their (a) efficiency, (b) durability. Letters of advice (135 in 1900) are written in reply to inquiry as to the suitability of agricultural machines. There is at this station a museum containing thirty-two agricultural machines of various kinds.

5. *The Agricultural Technological Institution of Hohenheim.*—There are four departments in the technological institution, etc. :—

(i) *Practical.*—(a) Distillery. Production of alcohol from October to March, over 3,000 gallons (b) Brewery. Production of beer from November to April, over 10,000 gallons.
(ii) *Theoretical.*—Theory of distilling and brewing.
(iii) *Research.*—(a) Investigations: distilling, brewing, composition of milk from various breeds of cows, etc, (b) Examination of wines, bacteria (wine, milk, etc.).
(iv) *Exp. station.*—(a) Fermentation industries and processes. (b) Testing brewing products, milk, etc. (c) Testing thermometers, alcoholometers, saccharometers, etc., etc.

6. *Farming and Breeding Establishments at Hohenheim.*—The farming and breeding establishments are employed for the following :—

(i) Rational treatment of cattle, sheep, pigs, poultry, fish, etc.
(ii) Dairying, milking, milk-testing, etc.
(iii) Inoculation of cattle (tuberculin).
(iv) Experiments with manures and fertilisers, ploughing, etc.

It may be mentioned that the greater number of imported agricultural machines are from the United States and Canada. Most of the machines formerly imported from Great Britain are now made in Germany; the British machines are deemed too heavy.

Recent additions to the institution are the agricultural chemistry building and the botanical building.

The ratio of teaching staff to pupils, including all assistants, is 1 to 4, excluding them, 1 to 5. The fees and income do not support the institution. The deficiency covered by State grant was £9,700 in 1901. About one-fourth of the pupils are foreigners (24 out of 107); so that if one reckons *pro rata*, this school *educates foreigners at a loss of about £2,200 annually.* There never, however, has been any illiberal regret at this.

Dr. Frederick Rose, His Majesty's Consul at Stuttgart, says (in his excellent report of 28th May, 1903) :—

"The Hohenheim School is certainly a powerful and visible argument in favour of the isolated and independent agricultural high school, situated in a rural district and keeping in close touch with practical agriculture. One of the most influential authorities in Germany in agricultural matters, one of those, I believe, who was instrumental in the gradual abolition of the independent farming academies, and their replacement by university agricultural institutes, lately passed several days at Hohenheim, with the object of studying the methods of instruction, and was much impressed by what he saw. At the present moment the tendency at the university agricultural institutes is the acquisition of fields and large plots of ground for practical and experimental work, a movement which would seem to indicate that the instruction afforded by the university institutes is not yet regarded as complete in all respects."

7. *The Agricultural High School of Berlin.*—Founded in 1860 as an agricultural institute, the Agricultural High School of Berlin was raised to its present rank in 1881. In scope of instruction, and in numerical strength, both as regards professorial staff and students, this establishment is said to be the largest and most important in Germany.

Organisation.—The general aim is to afford thorough theoretical and practical instruction and opportunities for research in agriculture, in agricultural engineering, in industries intimately connected with agriculture, and in allied scientific subjects, geodesy being among the number.

Under

Under the Ministerium of Agriculture, State Domains, and Forests, it is governed by a Rector, assisted by the "Curatorium," the upper and lower professorial councils, and three departmental councils. These offices are determined as follows :—

(a) *Rector.*—Elected for two years by the upper professorial council. Election ratified by the Monarch.

(b) *Curatorium.*—Two members charged with supervision of scientific interests of school; nominated by Minister of Agriculture, etc.

(c) *Upper Professorial Council.*—All fully qualified professors, together with others (not so qualified) are nominated by the Minister. The Council acts as an advisory board to Rector, and assists him in management.

(d) *Lower Professorial Council.*—All professors, lecturers, and assistants, determine instruction for each semester, and can propose general resolutions touching the aims and development of the school.

(e) *Three Departmental Councils.*—Principal professors in each department, viz.: (i) Agriculture; (ii) Geodesy and agricultural engineering; (iii) Agricultural-technical industries. Their duty is to promote the interest and study the well-being of their special departments.

The courses are four to six semesters (two to three years), viz., as follows :—

(a) *Agricultural course* commences autumn; lasts four to six semesters.

(b) *Geodesy* commences Easter; four to five semesters.

Students required to possess leaving certificate of Gymnasium, Realgymnasium, or Oberrealschule. Students of the agricultural high school may, if they please, attend lectures and practical work at the University, the technical and veterinary high schools, the mining academy. They may take the philosophy degree of the University in agricultural science, with philosophy and two other "natural" or "State Science" subjects as subordinate.

The professorial staff for 1901–2 was as follows :—

	No. of Professors.
Agriculture, forestry, horticulture, natural science	7
Physics and meteorology	2
Chemistry and technology	5
Mineralogy, geology, geognosy	1
Botany, vegetable physiology	5
Zoology, animal physiology	4
Veterinary science	3
Law and State science	1
Agricultural engineering	2
Mathematics and geodesy	3
Miscellaneous	7
Total	40
Assistants	25
Grand total	65

Attached to the Institution are those hereunder mentioned, with the number of officials indicated, viz. :—

	No. of Staff.
(i) Institution for fermentation industries and starch manufacture ...	47
(ii) Chemical laboratory of German Sugar Industry Association ...	5
(iii) Experimental station of the General Flour-mill Association ...	3
Total Professorial Staff, etc.	55

8. *Courses of Instruction—Berlin Agricultural High School.*—The following are the regular courses of instruction in several enumerated subjects :—

I Semester (winter).—General farming and cultivation (soils, drainings, etc.); principles of animal breeding; experimental physics; mechanics; heat, etc.; experimental chemistry; mineralogy, minerals; anatomy and morphology of plants; zoology, comparative anatomy (vertebrates); entomology (useful and noxious insects); domestic animals and their anatomy; agrarian matters and agrarian policy; law affecting land-cultivation; practical determination minerals, microscopy (specially referring to plant structure-histology).

II Semester (summer).—General farming and cultivation (irrigation, meadows, manures, etc.); breeding of horse, pig, etc.; chemistry and work in chemical laboratory; geology and geognosy; botany, plant-physiology (grasses, fodder plants, practical determination of); zoology, animal physiology (domestic animals, etc.); law, State science (Imperial and Prussian law, referring especially to farmers, surveyors, agricultural engineers).

III Semester (winter).—Special farming and cultivation (fodder, cereals); agricultural management and accountancy; cattle and sheep breeding, wool production; agricultural machinery and feeding methods; meteorology; botany (plant diseases and prophylaxis); veterinary science (hygiene and contagious diseases of domestic animals); practical planting, knowledge of soils.

IV

IV Semester (summer).—Special farming and cultivation (market produce); examination and valuation of soils; agricultural valuations; history of German agriculture; cattle demonstrations; dairies and dairying; veterinary science (internal diseases of domestic animals); skin diseases; farriery, etc.; practical agricultural management; practical breeding; physiological and zoological laboratory work; national economy and applications; optics and electricity (for students taking full course, *i.e.*, 3 years).

V Semester (winter).—Soils and soil valuation; utilisation of forest produce; fruit culture; spirit and starch manufacture; food adulteration, fodder, etc.; agricultural utilisation of moorland; animal physiology; practical work in chemical laboratory.

VI Semester (summer).—Machinery and building construction in connection with agricultural and allied industries (sugar refining, distilleries, breweries); agricultural architecture; land surveying and levelling; afforestation; kitchen gardening; pisciculture; practical work in the agronomic and in another selected laboratory; practical examination and valuation of soils.

The following subjects are mostly optional, though they are recommended and often taken:—

Winter Semesters (A)—Agriculture, horticulture, forestry, and fruit-culture.—Conversational lectures (Colloquia) on soils; practical laboratory investigations of plants, soils, manures; modern experimental agriculture and attained results; introduction to investigation of important agricultural materials, and to elementary bacteriology; experiments in wool testing and evaluation; practical testing, milk and dairy produce; questions concerning colonies; mechanics and theory of machinery; drawing; fruit-growing.

(*B*)—*Physics, chemistry, etc.*—Mechanics and practical physics; chemistry, chemical technology, chemical laboratory work and organic chemistry; distilling and starch manufacture; fermentation chemistry.

Botany and plant physiology.—Practical botany in the botanical institute; independent botanical investigation; technical and especially chemical botany; zoology and animal physiology; game (German), practical physiology for advanced students; practical physiological-chemical course.

(*C*)—*State science.*—National economics in relation to farming and to the question of labour; Social and agrarian questions in their present aspects.

Summer Semesters (A)—Agriculture, horticulture, and forestry.—Elements of manuring and of soil bacteriology; simple methods of investigating agricultural materials; introduction to agricultural, experimental and investigation methods; wool valuation; agricultural machinery; drawing; afforestation.

(*B*)—*Experimental physics.*—Optics, electricity, hydraulics.

Chemistry and technology.—Laboratory practice (chemical analyses); sugar manufacture; fermentation chemistry.

Mineralogy and geology.—Principal kinds of soil and their rational utilisation; mineralogical-chemical soil-analysis and its practical utilisation.

Botany.—Plant development with microscopic demonstration, and practical work for advanced students.

Zoology, animal physiology, pisciculture.

Entomology.—Useful and noxious animals (bees, silkworms, etc.); practical physiological-chemical course.

Veterinary science.—Hygiene of domestic animals; anatomy of domestic animals (repetition); building and agricultural constructions; State science and political economy.

The courses arranged by the German distilling, brewing, and starch interests provide for lectures and practical work in the following, viz.:—

(i) General and detailed management of distilleries.
(ii) Yeast manufacture, practical work in laboratory.
(iii) Starch manufacture.
(iv) Brewing and breweries.
(v) Examination of hops and determination of their value.
(vi) Chemical and microscopic work.
(vii) Selected subjects—Chemistry, physics, botany, machines, and machinery (with constructive drawing).

The fees for these courses are about £5 per month for lectures and laboratory practice.[1]

The laboratories of the German Sugar Industry Association are available for students who have already had some experience of laboratory work. The work in these embraces the investigation of sugars, gas analysis, practical microscopy, etc., etc.

The scheme of instruction, normally six semesters, is adapted also to the requirements of students who desire to finish their course in four semesters. The longer course is on a broader and more liberal basis, and is designed to ensure success in agricultural operations on a large scale, where, it is held, circumspection, theoretical, and practical knowledge must be combined. Many students, however, cannot (or seem indisposed to) devote so long a period. The students are warned, however, that they cannot profitably attempt to crowd the six semesters' work into the four semesters, so that they at any rate have the opportunity of doing their work thoroughly.

9.

[1] This is much higher than the ordinary fees.

9. *Geodesy and Agricultural Engineering, Berlin.*—The instruction for students of geodesy, and of agricultural engineering, is designed for four semesters, and so arranged that a fifth can be added. The course is not to be confused with a course in mere land subdivision.[1] The programme is as follows:—

Subjects.	Hours per week during each Semester.			
	I.	II.	III.	IV.
A.—*Mathematics and Physics.*				
Algebra ...	2	...	...	...
Analysis and analytical geometry	2	4	2	...
Descriptive geometry ...	...	2	...	...
Exercises in descriptive geometry	...	1	...	...
Trigonometry ...	2	...	...	...
Mathematical exercises	4	3	4	2
Mechanics	...	1	...	...
Dioptrics, optics, etc. ...	2	...	...	...
Hydraulics	...	...	1	...
Meteorology	...	1	...	...
B.—*Geodesy.*				
Practical geometry	3	3	...	...
Method of least squares	...	...	3	...
Exercises in same	...	...	3	...
Tracing of roads, etc. ...	...	2	...	...
Elements of higher geodesy ...	...	...	...	2
Calculations in general survey work ...	2	2	...	...
Practical work in higher geodesy	...	...	...	3
Exercises in drawing ...	2	2	...	...
Surveying (practical work, 1 day per week, during Whitsuntide week, and at the end of the term, 20 days altogether.)	1 day	2	1 day	2
Seminary attendance ...	...	...	...	2
C.—*Agricultural engineering and Building Construction.*				
Agricultural engineering	2	2	...	...
Design, drainage, and irrigation works	...	...	2	2
Agricultural engineering seminary ...	...	...	...	2
Earthworks	2	...	...	...
Building materials and building construction	2	...	...	...
Road and bridge building	...	2	...	...
Hydraulic engineering...	...	...	1	1
Projection of roadways, bridges, and hydraulic works	...	...	2	2
D.—*Law and State Science.*				
Imperial and Prussian law, with special reference to the legal aspects of surveying works, agrarian affairs and policy.	...	...	2	...
E.—*Agriculture.*				
Science of agricultural production ...	...	2	2	...
Grasses and fodder	...	...	1	...
Soils and soil judging ...	...	3	...	...
Exercises in the same ...	...	...	...	2
Scientific valuation of soils	...	...	1	...
Total	1 day + 25 hrs.	32 hours	1 day + 24 hrs.	20 hours
F.—*Optional and Recommended Studies.*				
Elements, inorganic chemistry	2	...	...	...
Experimental physics ...	3	3	...	...
Land reclamation, moor cultivation ...	...	...	2	...
National economics	..	...	4	...
Consolidation of lands and areas	...	2	...	...
G.—*For advanced students among the four terms, the following geodetical subjects:*—				
(a) Determination of geographical position.				
(b) Theory of charting geographical lines.				
(c) German geodesy and its organisation.				
(d) History of surveying.				
Instruction is given—				
(a) By lectures. (b) By practical and research in laboratories. (c) By means of collections, at the various departments. (d) By demonstrations, excursions, etc.				

[1] A somewhat absurd opinion that surveying is synonymous with land subdividing is very common.

10.

10. *Equipment of Berlin Agricultural High School.*—In the equipment may be mentioned:—

1. Cabinet for physics.
2. Chemical laboratory.
3. Mineralogy and geology department of museum.
4. Agronomical establishment and agronomy department of museum.
5. Botanical institute.
6. Plant collection.
7. Zoological institute and department of museum.
8. Physiological institute.
9. Zootechnical institute and department of museum.
10. Collection of machinery.
11. Seminarium for State science.
12. Seminarium for agriculture, plant culture.
13. Seminarium for agriculture, animal breeding.
14. Institute for agricultural experiment, bacteriology, etc.
15. Seminarium for agricultural engineering.
16. Seminarium for building technique.
17. Geodetical cabinet.
18. Seminarium for mathematics.
19. Institute for fermentation industries.
20. Institute for beet sugar industry.
21. Experimental station of the German Flour-mills Association.
22. Experimental granary.
23. Library.
24. Museum.

11. *Original Research in Agricultural Science, Berlin.*—The prosecution of original research work is a feature of the Berlin Agricultural High School. The following list is for 1901, and will give some idea of the educative value of the course.

Physics—
(1) Physics of everyday life.
(2) Dispersion of hail-clouds by cannon (Wetterschiessen; les tirs à grêle).
(3) Vertical distribution of atmospheric temperature, compiled from balloon ascents.
(4) Atmospheric refraction, light and sound.
(5) Relations subsisting between ascending and descending air currents and atmospheric electricity.
(6) Conferences respecting telegraphic weather information bureau.
(7) Two balloon ascents for investigation of atmospheric electricity.

Chemistry—
(1) Alcoholic fermentation without yeast.
(2) Chemical processes in sterilised yeast-cells.
(3) Studies on derivatives of pyrazol.
(4) Phenylacetylene and diazo-acetic-ester.

Geology, etc.—
(1) Seven excursions for practical work in compilation of geological maps.
(2) General geological excursions.
(3) Investigation of clays and marls from different geological formations.
(4) Degree of solubility of various soils and marls in acids of various temperatures and concentration.

Botany—
(1) Correlation of growths of roots and shoots of plants.
(2) Effect of Röntgen rays on plant organisms.
(3) The tissue and cause of fungoid growths.

Zoology—
(1) Fossil camels from Roumania.
(2) Discovery of new specimens of *Mesocricitus Newtoni.*
(3) Some Greek rodents.

Physiology—
(1) Biology of fats.
(2) Therapeutic utilisation of muscular activity.
(3) On the alleged poisonous effect of dyes "Mandarin" and of Metanil yellow.
(4) Effect of Becquerel rays on bacteria.
(5) Contributions to the spectroscopy of blood.
(6) The saccharine controversy.
(7) Effect value of meat.
(8) The relations between gall and the digestion of albumen.
(9) Combustion. Heat and effective value of foods.
(10) Fisheries and pollution of streams.

Agronomy. (Lectures, with debates, took place on the following subjects)—
(1) Profitable cultivation of sugar beet.
(2) Rational cultivation of potatoes.
(3) Drainage, and its practical effects.
(4) Application and effects of phosphate manures.
(5) Irrigation and meadow cultivation.
(6) Concentrated nitrogenous manures.
(7) Manuring with lime and marl.

Chemical

Chemical Laboratory—

(1) Apparatus for control of limekiln process.
(2) Alcohol-incandescent-light for polarisation apparatus.

Sugar Industry Association—

(3) Determination of beet sugar in preserved fruits containing starch.
(4) Scheibler's extraction method for beet-root polarisation determination.

It may be here pointed out that these are but a selection of the papers contributed. Mr. Consul Rose in his report (p. 24) says:—

"I wish to draw special attention to the signal capacity for original and independent research work displayed by German students at the higher scientific technical schools, as it forms one of the principal objects which ought to be aimed at by all methods of scientific technical instruction."

12. *Agricultural High School of Poppelsdorf.*—The Poppelsdorf agricultural school, founded in 1847, was supplemented by an experimental station in 1858, and in 1861 was raised to the rank of a higher agricultural academy.

It is intimately associated with the University of Bonn, and is under the direct control of the Prussian Minister for Agriculture, State Domains, and Forests.

Among recent additions, with excellent equipments for practical work and research, are the institutes for (1) soils and plants; (2) animal physiology; (3) vegetable physiology.

In general, the school is similar to the schools of Hohenheim and Berlin. The development, which may be taken as sufficient illustration of the development in other schools of the same character, has been as shewn in the table hereunder. It will be seen that the number of students is now steady, and about 345 per annum.

Year.	Students of— Agricultural Science.	Agricultural (Civil) Engineering.	Geodesy.	Bonn University and not fully qualified Students.	Total number of Students.
Average of years—					
1847–1852	23	......	......	4	27
1857–1862	60	......	......	14	74
1867–1872	47	......	......	7	54
1877–1882	31	34	......	5	70
1887–1892	31	8	67	8	114
1892–1897	41	9	259	13	322
1898	73	38	232	4	347
1899	115	28	198	6	347
1900	121	25	175	21	342

The Professorial Staff is as follows:—

Subjects of Instruction.

	No.
Full Professors—	
Physics and machinery	1
Chemistry and technology	1
Agricultural science	3
,, building construction, irrigation, and drainage	1
Animal physiology	1
Botany	1
Geodesy	2
Mathematics	1
Total	11
Lecturers, etc.—	
Fruit cultivation and garden produce	1
Veterinary science	1
Agricultural co-operative associations	1
Political economy	1
Forestry	1
Botany	2
Agricultural engineering	1
Mineralogy and geology	1
Agricultural science	1
Pisciculture	1
Elements of surgical assistance and ambulance work (first aid)	1
Agrarian legislation	1
Apiculture	1
Zoology	1
Assistants in the various departments	11
Total	26
Grand total	37

13.

13. *Fees at Agricultural High Schools.*—The fees at Hohenheim are as follows:—

		£	s.	d.
For Students from Württemberg	Semester I and II	9	10	0
	Semester III to VI	7	10	0
For Students from other German States, or for foreigners.	Semester I and II	14	0	0
	Semester III to VI	12	10	0

This includes lodging and attendance. There are 65 rooms available in the institution. The average expenditure for board is about 2s. per diem; students who wish to dine in the school pay £7 per semester in advance.

Further fees are as hereunder:—

	£	s.	d.
Chemical laboratory ...	0	8	0
Reading-room ...	0	4	0
Diploma examination (I) ...	1	10	0
„ „ (II) ...	1	10	0

At Berlin the fees are—

	£	s.	d.
Entrance ...	0	10	0
Leaving certificate ...	0	3	0
Final examination ...	1	10	0
Examination for future position on agricultural professorial staff	1	0	0
Surveying examination ...	0	15	0
Lectures per semester ...	6	0	0
Chemical laboratory, full term ...	1	0	0
„ „ half term ...	0	10	0
Agricultural laboratory ...	0	10	0

At Popplesdorf the fees are—

	£	s.	d.
Entrance ...	0	10	0
Matriculation and Bonn University ...	0	18	0
Final examination ...	1	0	0
Examination for future position on agricultural staff ...	1	0	0
Surveying examination ...	0	15	0
Lectures—Semester I ...	6	0	0
„ „ II ...	4	10	0
„ „ III ...	3	0	0
„ „ IV, etc....	1	10	0
Chemical laboratory ...	0	15	0

The agricultural high schools are not, of course, self-supporting, and require substantial grants from the State. For 1902 these were:—

Berlin ...	£11,700
Poppelsdorf ...	6,000
Hohenheim ...	9,400

The ratio of students to professorial staff for these three schools is:—

Berlin, 9·8 to 1; Hohenheim, 3·9 to 1; Poppelsdorf, 6·3.

The Examining Commission consists of the professors, who lecture on the subjects of examination, and is presided over by the Director of the School, and candidates are required to produce proof of attendance for at least four semesters.

These attendances may have been passed at any other agricultural high school in the University Institute, and moreover, two terms at any technical high school or University will be accepted if the subjects of study have been natural science and State science.

The examination is partly written, partly *viva voce.* In the former, a thesis in agricultural science is given, and one in some other subject can be chosen by the candidate. Eight weeks are allowed for the composition of the two theses, the candidate being required on oath to declare that they are his own (*i.e.*, done without assistance). The *viva voce* held after includes:—

(1) Agricultural Science, viz., (i) Crop cultivation; (ii) Breeding; (iii) Management; (2) Political economy; (3) Physics; (4) Chemistry; (5) Zoology and Animal physiology; (6) Botany and Vegetable physiology; (7) Geology and Mineralogy.

Both parts of the examination are evaluated under the terms,—

"Very good," "good," "satisfactory," "sufficient," "insufficient."

The second of these is counted twice in forming the average, and the candidate receives a certificate signed by the Examining Board shewing both detailed and general results. Those who are marked insufficient in *one* agricultural science subject, or in *three* other subjects, or in *both* written theses, are considered to have failed, and may not present themselves for six months.

14. *The Agricultural Institutes of German Universities.*—The following table will give an idea of Germany's University equipment for agricultural teaching:—

University.	Department.	Fully qualified Professors	Students in 1902.
Breslau ...	(1) Agricultural production (plant)	2	46
	(2) Agricultural production (animal)	2	
	(3) „ chemistry and bacteriology	1	
	(4) „ technology	1	
	(5) Two examination committees...	...	
Göttingen ..	(1) General agriculture	1	75
	(2) Agricultural-chemical laboratory	1	
	(3) Agricultural experimental grounds	1	
	(4) „ bacteriological institute	1	
	(5) „ experimental station	1	
	(6) Two examination committees	...	
Halle	(1) General agriculture	1	196
	(2) Animal breeding	1	
	(3) Veterinary clinic	1	
	(4) Agricultural machinery	1	
	(5) Experimental laboratory	1	
	(6) Experimental grounds...	1	
	(7) One examination committee	...	
Jena	(1) General agriculture	...	49
	(2) Agricultural laboratory	2	
	(3) Agricultural botanical garden		
	(4) Experimental fields and tree nurseries		
	(5) Agricultural-chemical laboratory	1	
	(6) Veterinary department	1	
	(7) Two examination committees...	...	
Kiel	(1) General agriculture	1	8
	(2) One examination committee	...	
Königsberg ...	(1) General agriculture	1	60
	(2) Agricultural physiological laboratory	1	
	(3) Agricultural botanical garden	1	
	(4) Veterinary clinic	1	
	(5) Two examination committees...	...	
Leipzig ...	(1) General agricultural department	1	117
	(2) Experimental department	1	
	(3) Pædagogic agricultural seminary	1	
	(4) Veterinary institute and clinic	1	
	(5) Examination committees for the State examination in agriculture, the diploma examination, pædagogic agricultural science, inspecting positions, and for agricultural-chemical engineering	...	
München (Tech. Hochschule.)	(1) General agriculture	3	61
	(2) Agricultural chemistry	1	
	(3) Special cultivation methods	1	

A sufficient indication of the character of the work done will be obtained by considering the instruction at München[1] and at Königsberg.

Munchen.

Year I.—National economy; experimental physics; inorganic experimental chemistry, including the elements of physical chemistry; organic chemistry; mineralogy; crystallography; general botany; special and systematic botany; comparative anatomy of domestic animals; general zoology; embryology and development of domestic animals. *Optional*—Chemical laboratory; miscroscopic laboratory; technical drawing.

Year II.—Geology, chemistry and knowledge of soils, meteorology and climatology, physiology of animal organisms, I; nutrition of plants, general field and garden cultivation, meadow cultivation, diseases of garden and field plants, contagious diseases of animals, agricultural machines and tools, plant nurseries. *Optional*—Physiology of animal organisms, II; microscopic laboratory, practical zootomic work, experimental agriculture (practical), valuation of soils, poultry breeding.

Year III.—Special plant cultivation, feeding and fodder, general breeding and hygiene, special breeding, agricultural management, agricultural technology, I (fermentation industries, sugar and starch manufacture), agricultural technology, II (dairies), drainage and irrigation, agricultural constructions. *Optional*—Pisciculture, land reclamation, moor cultivation, agricultural calculations and estimates, agricultural experimentation, agricultural laboratory and agricultural-chemical laboratory, practical demonstrations on the experimental plots and estate and in the dairies, further in-breeding, practical agricultural (civil) engineering.

Königsberg:—

[1] In the "Landwirtschaftliche Abteilung" of the Royal Technical High School (die königliche technische Hochschule zu München).

Königsberg :—

I. *Agriculture.*—Agricultural management; valuation of estates; general crops production; special crops production; meadow cultivation; market produce; scientific basis of plant cultivation; moor cultivation; diseases of field and garden crops; general breeding; special breeding; milk production; butter making; cheese making; physiology of domestic animals; external diseases of domestic animals; contagious diseases of domestic animals; horse breeding; agricultural chemistry, I (feeding and fodder of domestic animals); agricultural chemistry, II (nutrition of plants); noxious insects; agricultural bacteriology; micro-organisms in fermentation industries.

II. *Agricultural (civil) engineering, agricultural machinery and tools.*—Surveying, levelling, and plan drawing; agricultural machinery and tools; irrigation and drainage.

III. *Natural Science.*—Chemistry; physics; mineralogy; geology and palæontology: zoology; botany; astronomy; selected branches from bacteriology.

IV. *State Science.*—Theoretical and general national economy; financial science; introduction to State science; practical national economy; political economy; commercial politics; history of national economy; public credit; social politics; Socialistic theory and Socialistic movement in Germany.

V. *Demonstration and practical work.*—Experimental laboratory work with reference to breeding and milk production; chemical laboratory; practical bacteriology; agricultural-physiological laboratory; agricultural book-keeping and calculations; demonstrations in the animal clinic; demonstrations in the botanic garden; agricultural excursions; seminary for State science; exercises in political and financial economy.

VI. *General Educational Subjects.*—Selected law; philosophy; psychology; æsthetics and ethics; mathematics; geography; history; archæology; history of art; literature; modern languages.

15. *Agriculture and Brewing Schools.*—In Bavaria (Bayern), the Agricultural and Brewing Academy of Weihenstephan[1] may be taken as a sufficient illustration of this class of school. Founded at Schleissheim (Munich) as a farming academy in 1818, it was reorganised in 1852, and raised to its present rank in 1895.

The conditions of entrance for students are:—

(1) That they have passed the "Einjährige Examen" (educational qualification reducing the compulsory military service to one year).
(2) That they are at least 17 years of age.
(3) That they have had one year's practical work.
(4) That they produce certificates of good conduct.
(5) If under age, that they produce permission of parents, etc.

The plan of instruction covers two years in agriculture, one year in brewing, the fees being, for Bavarian students: Agriculture, £2 10s.; brewing, £5; and, say, 50 per cent. higher for foreign students.

The professorial staff, etc., is: Professors, 11; lecturers, etc., 12; assistants, 5; total, 28; and, as there were 125 students in 1902, the ratio is 4·5.

The courses are:—

Agriculture :—

Year I. *Winter Semester.*—Physics; general knowledge of machinery; inorganic chemistry; zoology; botany; political economy; anatomy and physiology of domestic animals; agricultural machines and tools; technical drawing; microscopic practical work; zoological practical work.

Summer Semester.—Organic chemistry; mineralogy and geognosy; botany; zoology; physiology and pathology of plants; plant nutrition; anatomy and physiology of domestic animals; general breeding; hygiene of agricultural domestic animals; pisciculture; surveying and levelling; chemical laboratory; practical agriculture.

Year II. *Winter Semester.*—Field produce; special breeding (cattle, horse, poultry); veterinary obstetrics; management; book-keeping; agricultural technology (dairy produce, distilling, brewing); forestry; fruit and garden produce; agricultural law; agricultural-chemical laboratory; dairy work.

Summer Semester.—Plant and meadow cultivation; hop-growing; drainage and irrigation; fodder and feeding; special breeding; elementary veterinary science and agricultural pharmacopœia; management and valuation; management of the school estate; forest law; agriculture; practical orchard and garden cultivation; commercial geography; agricultural bacteriology; plant-growing.

Brewing :—

Winter Semester.—Physics; general knowledge of machinery; inorganic chemistry; chemical analysis; botany (with special reference to yeast plants); hop-growing and knowledge; general technology of brewing; brewery management; book-keeping and commercial science; technical drawing; practical chemistry; microscopic work; practical brewing; distilling.

Summer Semester.—Brewing machinery and construction; organic chemistry; fermentation chemistry; zymotechnic analysis; barley; general technology of brewing; cultivation of yeast plants; commercial science; building construction; practical zymotechnic work; practical fermentation work; law; commercial geography; hop-growing; political economy.

16.

[1] Weihenstephan was formerly an abbey. It is about 26 miles northerly from Munich. (Königliche Akademie für Landwirtschaft and Brauerei in Weihenstephan.)

16. *Special Agricultural Courses.*—Courses of, say, from twenty-five to thirty lectures are given in several Prussian high schools of agriculture, university institutes, etc., and also in Saxony, Hesse, Würtemberg, etc., suitable for educated owners, managers, agents, large farmers, etc.

These take place during some one week in winter, and present a sketch of the progress made in agricultural and natural science, in jurisprudence, political economy, and similar subjects of interest to the hearers

Owners, managers, etc., go to town, stay for a week in attendance at the lectures, and thus come into touch with all that is new of interest to them. By means of evening discussions, opportunity is offered for interchange of opinion between the practical and well-educated agriculturists of the country and the theoretical and still better educated agriculturists of the schools. Such discussions are found to be very valuable, for both parties, being professionally educated, are able to discuss the questions at issue in the light of the best available knowledge, and with both practical and scientific discernment. The attendances at these courses are large (often 300).

Part II.—Secondary Agricultural Education in Germany.

17. *Secondary Agricultural Education.*—Secondary agricultural instruction is provided for in agricultural schools, the course lasting six years. In Prussia, these were organised under the law of 1875; they exist in other German States also. The following list will give an idea of their number.

In Prussia there are schools at—

Heilenberg.	Eldena.	Liegnitz.	Lüdingshausen.
Margrabowa.	Schievelbein.	Flensburg.	Weilburg.
Marienburg.	Samter.	Hildesheim.	Cleve.
Dahme.	Brieg.	Herford.	Bitburg.

In other States there are—

Döbeln, in Saxony; Gr. Umstadt, in Hesse; Varel an der Jade, in Oldenberg; Helmstedt, in Braunschweig; Köstritz, in Reuss; Rufach, in Elsass.

These schools are private schools, *subsidised by the State;* and their income is made up from fees, and from various public and private sources, in addition to the subsidies. The teachers occupy positions identical with those of State schools of six classes; the instruction in the lower classes corresponding to that given in the Realschulen, and in the upper, following a definite plan specially developed for the education of sons of farmers, and of managers and estate owners, who acquire some practical and theoretical knowledge of agriculture while qualifying for the "Einjährige Examen."

The schools are administered by a "Curatorium," and are under the supervision of the Ministries of Agriculture and Education.

The fees are about £6 yearly, payable in four instalments. The school at Döbeln, a town of about 16,000 inhabitants, about 32 miles south-easterly from Leipzig, in a direct line with Dresden, may be taken as an example. The agricultural school is connected with the "Realgymnasium." The staff numbers thirty-four.

The programme of instruction is as follows:—

Subjects.	Classes and Hours per Week.					
	Lower Division—General Education.			*Higher Division*—General and Agricultural Education.		
	I.	II.	III.	IV.	V.	VI.
Religion	3	3	3	2	2	1
German	4	6	5	5	4	4
Latin	8	......	......	......	......	......
French	......	6	6	6	5	4
History	1	1	2	2	2	2
Geography	2	2	2	2	2	1
Arithmetic and mathematics	5	5	6	6	5	4
Elementary natural science	2	2	2	4	3	2
Physics	......	......	......	2	2	1
Chemistry	......	......	......	2	3	5
Agricultural production	......	......	......	......	3	4
" management and political economy	......	......	......	......	......	3
Book-keeping	......	......	......	......	1	1
Surveying and plan drawing	......	......	......	......	......	2
Drawing	2	2	2	2	2	......
Gymnastics	2	2	2	2	2	2
Singing	2	2	1	2[1]	2[1]	2[1]
Shorthand	......	......	......	2[1]	2[1]	2[1]

[1] Optional.

The condition of entrance to Class I is that the pupils must have gone through three years in a preparatory school (Vorschule.)

18.

18. *Teaching-staff of a Secondary Agricultural School.*—The equipment, both as regards the teaching personnel and material, is such as to ensure high efficiency.

In the Prussian agricultural schools the qualifications for *masters* are as follows:—

(1) Completion of full course at a Gymnasium or Oberrealschule.
(2) Completion of three-year course in agriculture at an agricultural high school, or at the agricultural institute of a University.
(3) Practical engagement in agriculture for not less than two years.
(4) Satisfactory completion of probationary period of one year as Master of Agricultural Science at an agricultural school.

The examination of a master (2) is passed under the following conditions:—

(a) It may be passed at an agricultural high school, or a University-institute of Agriculture.
(b) The candidate must have stated his intention of acquiring the qualification for master of an agricultural secondary school.
(c) The examination is partly written, partly *viva-voce*, the former including—(i) A set thesis on some branch of agricultural science. (ii) A thesis on a particular branch of natural science (selected by candidate himself).

The latter embraces—

(d) Examination (*viva-voce*) in whole field of agricultural science, physics, chemistry, botany (with plant-physiology), zoology and animal physiology, mineralogy and geology, elements of national economy and agricultural law.
(e) A special declaration must be obtained from the Examining Commission that the *knowledge* and *capabilities* of the candidate constitute a suitable qualification for position of master of agricultural science at an agricultural high school.
(f) To secure a certificate of proficiency it is necessary to pass satisfactorily in *each* of the three subjects—(i) Agricultural management; (ii) Plant cultivation; (iii) Breeding.

And not to fail in *three* of the natural science subjects, but in the last, excellence in one subject will compensate for deficiency in another; not so, however, in (i) to (iii).

Candidates who fail in the less important subjects may present themselves in six months for re-examination in their weak subjects: those who fail generally have to wait one year.

It is important to remember that a certificate of competency as master in agricultural science qualifies to teach in agricultural science only, and *not in general subjects.*

19. *Equipment of Secondary Agricultural Schools.*—The secondary agricultural schools are properly equipped for practical teaching—that is, agricultural work, and practical investigation and research. Thus a school possesses about the following equipments:—

(i) A physical laboratory.
(ii) An agricultural-chemical laboratory.
(iii) Various buildings for experiment, etc.
(iv) A good-sized botanical garden.
(v) An orchard.
(vi) Several acres of experimental plots.

When in direct connection with a Realgymnasium, it has the advantage of the general scientific equipment of the gymnasium, which in Germany is always excellent.

It will be seen that the opportunity for getting advanced and secondary agricultural instruction is well developed throughout Germany; and it is important to notice that the teaching-staff is thoroughly qualified *theoretically*, *i.e.*, *scientifically*, for the work it undertakes.

It is this thorough scientific training that stands for so much—the ability to bring to bear upon everyday practice an enlightened and scientifically educated intelligence. That is the secret of the success in the farming operations of Germany.

Besides the above, however, Germany still provides for lower forms of agricultural instruction, which will be referred to in the next part, viz., III.

Part III.—Elementary Agricultural Education in Germany.

20. *Introductory Remarks.*—In Belgium, France, Germany Holland, etc., it has been found desirable to afford the peasant classes some instruction in agriculture of a very elementary and yet useful character. In connection with this, an excellent report by Mr. T. G. Rooper may be found in the Special Reports on Educational Subjects of the Board of Education, London, vol. 9, pp. 357–404. This was undertaken in May, 1901, and published in 1902.

The aim of practically all, certainly the better class of teachers engaged on this work, is primarily distinctly *educative, rather than utilitarian*—that is to say, they aim at habituating the peasantry to thinking, and to basing their practice on thinking, rather than on the blind following of routine.

The combination of school-work with out-of-door garden work is believed to lead to a clearer understanding of scientific principles than is attained through indoor work only. As illustrative of the spirit of the teaching, an incident referred to by Mr. Rooper is worthy of note. After pointing out a number of cottage gardens shewing the influence of the teaching, the German teacher remarked:—

"But after all, it is not so much the amount of information or skill that I may impart which counts with me, as the spirit which I have succeeded in arousing amongst the boys, and the happiness which I have introduced into their lives. Such is the foundation I am satisfied with laying, and on this in their after life they will be able to build with success. In the end, the result of the work which is done in any school will depend upon the individual methods of the teacher."

Another point worthy of note is, that in the elementary school the syllabus is a *general guide*; no teacher is absolutely tied down to it.

21.

21. *Elementary Agricultural Instruction.*—This is given, as said in section 1 of this chapter, in several forms of schools, viz., (1) Farming schools; (2) Lower agricultural winter schools; (3) Special lower agricultural schools; (4) Rural improvement schools; (5) Special elementary courses of lectures; (6) Agricultural instruction in elementary schools.

The following will give some idea of the number of schools of different kinds:—

Farming Schools.

Prussia	26	Weimar	2	Oldenburg	1
Bavaria	5	Anhalt...	1	Reuss	1
Saxony...	3	Baden	1	Saxe-Altenburg	1
Württemburg... ...	3	Mecklenburg-Schwerin	1		
				Total	45

Lower Agricultural Winter Schools.

Prussia	118	Saxony...	6	Saze-Meiningen... ...	1
Bavaria	21	Oldenburg	4	Schaumberg-Lippe ...	1
Baden	12	Bremen	1	Walbeck	1
Elsass-Lothringen ...	10	Lippe	1		
Hesse	9	Lubeck	1	Total	195
Württemberg... ...	8	Mecklenburg-Schwerin	1		

Special Agricultural Schools in Prussia alone.

Rural Improvement	1,079	Schools—	15,169	Pupils.
Garden produce and Fruit-culture	104	„	3,892	„
Shoeing	48	„	720	„
Rural Housekeeping	42	„	1,870	„
Dairy	17	„	428	„
Breeding courses	10	„	800	„
Miscellaneous	8	„	191	„
Meadow-cultivation	7	„	385	„
Book-keeping (agriculture, etc.)	4	„	90	„
Distilling and Brewing	3	„	367	„
Total for Prussia (alone)	1,322	Schools—	23,912	Pupils.

Throughout Germany there are a number of special agricultural schools or courses, and in the rural schools the instruction is not merely orientated towards agriculture, but agricultural instruction is given as part of the ordinary school course. This procedure is perfectly satisfactory where on the whole the peasants' children remain peasants, or where the farmers' children rarely think of abandoning the calling of their fathers.

22. *Farming Schools.*—The organisation of the farming schools is peculiar. There are three in Würtemberg, under the direction of the Minister of Education, and Royal Bureau for Trade and Commerce (Stuttgart); these may be taken as typical. They are managed by a practical farmer, who, as director of the school, rents the adjunct-farm, and *at his own risk* cultivates it as a State tenant, possessing, however, during his directorship and tenancy the rank of a government official. The areas of these farms are from 300 to 400 acres (Ellwangen, 292 acres; Ochsenhausen, 310 acres; Kirchberg, 480 acres).

The director's duties are:—

(a) To give instruction in agriculture;
(b) Also in subordinate and allied subjects;
(c) To superintend other branches of instruction.
(d) To maintain discipline.
(e) To work the estate as regards products and methods, in such a way as shall agree with a plan of instruction fixed by the higher authorities.

He is assisted by—

(f) An instructor.
(g) A farming inspector.
(h) A veterinary surgeon.

The course lasts for three years; pupils must be at least 17 years of age, vigorous, and healthy, and must have qualified in the lower schools. They must, further, understand ordinary farm work; and their number at any one school is limited to 12. The pupils give their labour in the practical work of the farm, and study and work under the following conditions, viz.:—

(i) They do not pay fees.
(ii) Board and lodging are provided gratis (including furniture, bed clothes, and washing utensils).
(iii) They are required to work ten hours in summer, eight in winter; at harvesting two more hours are required.
(iv) Their work must be done with diligence and carefully; they must be punctual.
(v) They have no regular holidays.
(vi) Short periods of absence are granted on application.
(vii) Food is supplied by director in return for the work performed by the pupil.

The

The instruction is in both *theoretical* and *practical* and covers the following range:—

Theoretical and practical.—(a) Climatology; soils; plant, fruit, and grape cultivation; grass and hay growing; breeding domestic animals; instruction in agricultural trades; stocking and working farms: keeping books and accounts. (b) German composition; arithmetic; geometry; elementary natural science; general subjects.

Practical.—Handling agricultural machinery; beetroot cultivation; irrigation and drainage; regulation of brooks and streams; manuring, sowing, harvesting, hop-growing; threshing, cleaning, measuring, packing of grain, fruit, etc.; repair of machinery, tools, etc.

It will be seen that this class of instruction, designed for peasants, small farmers, and tenants, is eminently practical, and the Director, having to make his farm pay—for it is at his own risk—is under every inducement to adopt good practical methods. At the same time he is under the temptation to sacrifice the interests of his students to his personal interests.

During the period of heavy work, as at harvesting, theoretical instruction is postponed; this is, however, no disadvantage. Of course, the obvious defect is that the financial aspect has always to be present to the Director, and he may be tempted occasionally to sacrifice the educational aspect thereto. On the other hand, there is no temptation to undertake merely theoretical experiments (important, of course, in higher schools undertaking research), which are somewhat beyond the educational qualifications of those of lower grade agricultural education.

23. *Agricultural Winter Schools.*—There are eight agricultural winter schools in Würtemberg, the course commencing about November and ending before April. These may be taken as typical. They are intended for sons of peasants who desire to become either farm labourers or small farmers. The courses are framed to meet the following requirements:—

(1) To consolidate and extend the school education.
(2) To give satisfactory ideas as to the principal agricultural processes on small farms.

Pupils are required to be 15 years of age, and to have had an elementary education. The fees are about 25s. per course which covers:—

(a) German, caligraphy, arithmetic, drawing.
(b) Geometry and surveying, physics.
(c) Agriculture, breeding of domestic animals.
(d) Farm management, book-keeping.
(e) Elementary veterinary surgery.

The schools are under the same supervision as the preceding, and though the expenditure is partly borne by the State, the local community is required to provide the schools with furniture, lighting, and heating. An idea of the size of these schools may be had from the following list giving the number of pupils:—

Gmünd	28	Leonberg	25	Ravensberg	32
Hall	19	Reutlingen	32	Ulm	28
Heilbronn	34	Rotweil	28		
				Total	226

24. *Special Agricultural Schools.*—There are schools for special forms of agriculture—for example, the grape-culture and vine school at Weinsberg. The object is, for example, to instruct the sons of peasants in the following, viz.:—

Viticulture, wine-making, plant and tree growing, etc., so that they shall be qualified to deal with their lands in a rational and profitable manner. These schools, directly under the supervision of the Royal Bureau of Trade and Commerce, which nominates the pupils, limited to twelve at each school, are *free;* so also is the boarding and lodging therein. The course is two years, the pupils give their labour on the attached estate (about 85 acres) receiving a small honorarium on leaving. The expenses are borne by the State. The instruction covers about the following:—

(a) German, arithmetic, geometry, drawing.
(b) Elementary chemistry, physics, mechanics.
(c) Climatology, soils, manures.
(d) Tools, etc.
(e) Viticulture; wine-making and storage.
(f) Fruit, vegetable, hop, and tobacco growing.
(g) Breeding of domestic animals; farm management.

25. *Travelling Lecturers on Agriculture.*—Throughout Germany travelling lecturers disseminate important agricultural information by a system of local lecturing, having for its object the stimulation of the peasants and small farmers, so that they may do their work rationally and be led to make experiments. The lecturers are often officials in the pay of the Chambers of Agriculture, or the larger agricultural societies; sometimes they are masters of the lower agricultural schools. The Royal Bureau for Trade and Commerce promotes and assists activity of this kind.

The lectures range over a variety of subjects, such, for example, as:—

(a) Fruit culture, viticulture, tobacco growing.
(b) Breeding of domestic animals, of poultry, of fish.
(c) Field products, meadow and garden products.
(d) Artificial manuring, drainage, etc., etc.

When it is borne in mind that the lecturers are suitably educated men, who have also real experience, it is obvious that the results of such lecturing must be very valuable. It should be borne in mind that there is a great difference between the teaching of men whose earlier education has been thorough, and who then specialise, and that of uneducated or of poorly-educated men, who are merely a little above the average in practical agriculture or general information.

26.

26. *Elementary Agricultural Education.*—Instruction in agriculture in elementary schools is not of recent origin in Germany. In Schleswig-Holstein, as far back as 1814, it was directed that, "in view of the future occupation of children in country schools, most of whom will be engaged in agricultural pursuits, some instruction in fruit and vegetable culture should supplement the ordinary programme." In Nassau, in 1817, village schools had to be provided with garden plots, in addition to their recreation areas. In 1819, the Prussian authorities directed that in village schools some attention should be given to agricultural subjects; a direction that has, however, been only partly carried out. In Mecklenburg-Schwerin it was required that all village schools should have fruit-gardens for instruction purposes; but in 1846 the matter was practically left to the discretion of the teacher, with the result that school gardens are the exception, not the rule.

The following is a syllabus of the programme of the school at Geistingen, a little village of about 1,400 inhabitants, a few miles south-easterly from Cologne. There are three divisions in the school—lower, middle, and upper:—

Instruction in Natural History.

Year I.—Middle Division.

Lark, sparrow.
Cockchafer.
Snowdrop and violet.
Swallow, titmouse, and nightingale.
Flowering fruit-trees and bees.
Robin and hedge-sparrow.
Poisonous crowfoot and nightshade.
Poisonous mushrooms.
Water-wagtail, thrush.
Rye, wheat, oats, barley.
Potato.
Hare and rabbit.
Beans, peas, and clover.
Hedgehog, bat, mole.
Hen, pigeon, duck, birds in winter.
Dog, cat, mouse.
Ox, goat, pig, sheep.
Horse, ass.

Year II.—Middle Division.

Starling, wren, cuckoo.
Rose, forget-me-not.
Cabbage-butterfly and caterpillar.
Poppy.
Wasp, hornet, ant.
Corncockle, foxglove.
Turnip-fly and bluebottle.
Worms, ladybird.
Turnip, carrot, cabbage, onion.
Crow, owl.
Herring.
Shrew-mouse, squirrel, weasel.
Oak.
Fir.
Beech.

Year I.—Upper Division.

The parts of a Plant—

Root, stem, leaf, buds, flowers, fruit, seeds.
The nature of each part of a plant, and how it acts.
Absorption and transpiration; chlorophyll; effect of light and warmth.

Food of Plants—

How derived from the soil; the cambium layer; the annual rings.
Kinds of food: (i) Gaseous—oxygen, hydrogen, nitrogen, carbon dioxide; (2) Mineral—sulphur phosphorus, calcium, potassium, iron.

How Plants supply Animals with Food—

Supply of matter to plants for food by stable manure, compost, wood-ash, artificial manure, and diluent substances, such as lime.

Effect of Climate in Plants—

Water: water in the ground; how plants absorb water.
Seeds and cuttings.
Rich and poor soils; improvement of poor soils: clay, peat, lime.
Loam, sand, mixed soils.
Simple analysis of soil.
Manuring, humus, irrigation.

Fruit trees and their improvement—

The parts of a fruit tree; the wild stock and its treatment.
The chief kinds of improved fruits.
Grafting: crown grafting, etc., budding.
Improvements of stone fruit, gooseberries, and roses.
Treatment of young trees in their nursery.
Treatment of berries, viz., gooseberry, raspberry, strawberry, currants.
The vine and its treatment.
The hazel-nut.
Espaliers: special attention to the walls of the schoolhouse.
Choice of sorts, according to aspect, soil, temperature, rainfall, and altitude.

Care of Fruit trees—

Planting fruit-trees; trimming root and crown; watering; support.
Attention needed during the first year after planting; renovating fruit trees.
Diseases of fruit-trees; insect pests and remedies; mildew, canker, moss, gum.
Injury from hail, snow, hares, rabbits, and various birds and insects—starlings, beetles, codlin moth, wasps, spiders, woodlouse, onion-fly, etc.
Ripening of fruit; sorting and storing fruit.

Year

Year II.—Upper Division.

The vegetable garden :—

Division of the ground—trenching and manuring, sowing seed, planting, watering, weeding, forking, hoeing.

The hotbed.

Various kinds of cabbage, cauliflower, broccoli, lettuce and endive, radish, spinach, carrots, turnips, onions, celery, beans, peas, scarlet-runners, asparagus, preserving vegetables.

Field crops :—

Preparing the ground—ploughing, harrowing, rolling.

Wheat, rye, oats, barley, potatoes, beetroot, vetch, clovers, grasses for pasture.

Weeds in garden and pasture, and their removal.

Necessity for manuring pastures and tilth.

The enemies of plants and their destruction—moles, field-mice, centipedes.

The friends of plants—bees, hedgehog, ladybird.

The co-ordination of various subjects of instruction, and their orientation agriculturally is shewn by the results of an examination reported by Mr. T. G. Hooper.[1] He found that they could answer questions relating to the following :—

(*a*) Natural Science :—(1) Classification of the plants in the garden; (2) the names of all the plants and their use.

(*b*) Arithmetic :—Estimate of the cost of producing a crop in one of the beds, from sowing to marketing; (2) Estimate of the amount of water draining away from the garden in twenty-four hours; (3) Calculation of the height of a tree from the measurement of its shadow.

(*c*) Drawing :—(1) Freehand drawing of leaves of plants from nature; (2) Plan of part of the garden drawn to scale from measurement on the spot; (3) Perspective drawing of the beehive and stand.

(*d*) Geometry ;—(1) Calculation of the area of a circular portion of the garden; (2) Laying out a rectangular bed of given dimensions; (3) Measurement of the slope of the garden; (4) Calculation of the quantity of water contained in a cylindrical basin in the garden.

(*e*) Practical knowledge of gardening :—(1) Treatment of a garden bed; (2) Treatment of a manure heap; (3) Exposition of practical experiments as follows :—(*a*) With nineteen different kinds of grasses; (*b*) With several different kinds of potatoes, and same potatoes differently planted; (*c*) With "Triumph" oats in respect of (1) deep cultivation; (2) different manures.

(*f*) Practical treatment of fruit-trees :—(1) Grafting, budding; (2) Planting a fruit-tree; (3) Treatment of the bark; (4) Summer pruning of a pyramid tree.

In connection with the practical teaching the following account by Mr. Hooper is of interest. It relates to work seen at an elementary school at Oelsberg, a little village of Westphal, and situated on the Ruhr. It may be mentioned that the fruit-gardens in the neighbourhood bear testimony to the excellence of the local teaching. The passage is as follows :—

"Some of the practical work in connection with the fruit-growing is done in the class-room. The boys are told to bring suitable shoots and stocks, and they learn to make various grafts and buds in the room. Later they perform actual work of this kind out of doors in a nursery provided for the purpose. Near the school the parish has given a sheltered slope, about an acre, rent free. The master buys the young fruit-trees, wild stock, etc., and manure, which, owing to the local system of sanitation, is easily obtainable. The boys in this school learn nothing of vegetable gardening. The garden contained a large number of young fruit-trees in various stages, viz., young stocks, stocks which the boys have grafted, and standard trees, with their crowns properly formed and ready for transplanting. A large section had just been sold off and was cleared. The sorts are such as the master has found by long experience to be best suited to the locality which, being fairly high up, requires sturdy trees. The village is too high up for the culture of the vine. The trees which grow best are apples and pears, and a demand for cherries is growing. Peaches and apricots will not ripen. The demand for the master's trees is so great that the parish is providing a larger plot of ground. The boys leave school at 14, and there is no continuation school in the village."

The arrangement of practical work is as hereunder :—

January—

Cleaning fruit-trees from moss and old bark; lime-washing; cutting away dry wood in the crown, and removal of unnecessary branches; covering the wounds with proper wax (in place of tar, which is injurious); cutting and storing scions of good sorts.

February—

Spring pruning; destruction of enemies of fruit-trees.

March—

Complete the work of the preceding month; planting fruit-trees; preparing hole; trimming roots; prop, planting in soil, binding to prop.

April—

Improving stock by various grafts—tongue grafts, crown grafts, etc.; budding, shaping the crown of the young fruit-trees.

May—

Complete the work of April; watering fruit-trees.

June—

Diseases of fruit-trees; injury from frost; canker; blight.

July—

Diseases; gum; sterility.

August—

[1] Op. cit., p. 370.

August—

Inoculating fruit-trees. (From April to the end of August attention must be paid to weeding and keeping the soil clean.)

September and October—

Gathering and storing fruit; study of fruits which are suited to the climate of the school.

November—

Manuring the soil; preparing ground for spring planting; cleaning fruit-trees.

December—

Study of the soil, climate, and situation of the fruit garden; protection against frosts and noxious insects.

27. *Moral and Social Advantages of Elementary Agricultural Instruction.*—The interest awakened in children appears to be very great, the tendency to mischief is corrected, the natural amusements of children are promoted, and the pernicious aping of adult practices is minimised. The opinion of Herr Wilsdorf of Plauen is thus quoted by Mr. T. G. Hooper:—[1]

"School life is only one of the many influences which act on the schoolboy. There are also his home, and the life which is led by his parents, the influence of his companions out of school, all that he hears in chance way from grown up people, and all that he reads for himself. Great as is the influence of the school and the teacher, it is a mistake to attribute to these alone all the success or failure of the youth as he grows up.

"There is no doubt, however, that the instruction which is given in school has sometimes been too little connected with home life, and that there has even been some opposition between them, so that what has been most regarded as of value in the home has been depreciated and even despised at school, while the lessons in school have often been regarded by parents as possessing little practical value.

"There is an opportunity at the present time, such as has never existed before, of knitting together more closely home and school life. This is due to the advance of modern science, and to its application to the common affairs of everyday life in the house and in industry.

"An ordinary boy will take much more interest in the explanation of some fact in one of his lessons on natural science if he combines his lesson in school with some practical work in which he can use his hands.

"This is equally true of his lessons in geometry and arithmetic. A teacher who is in the habit of thinking out the practical bearing of his lessons derives much benefit both for himself and his scholars.

"Partly he finds himself able to omit what is unessential, partly he is able to shew his scholars how to find out for themselves details which they may need to know, and partly he is able to seek and find sympathy with the parents by shewing them that he wishes to impart living knowledge, and to make their sons useful at home and thoughtful in the exercise of any practical work which they may undertake.

"Work in the school-garden offers the teacher the opportunity of carrying out this kind of instruction.

"More than this—a change is coming over the aims of the teacher of science. *The acquisition of so much knowledge of system and classification as can be included in a text-book of science is really becoming to be regarded as so much 'examination fodder,' having no further value than the attainment of a diploma.*

"The first step in teaching science is to direct the child to the observation of the life, growth, and habits of living things. It is thought more important than formerly to direct the child's attention to living matter and the slow patient toil which is needed to grow plants with success, or to rear poultry, or to keep bees.

"Dealing with dead matter and chemical analysis and mathematical calculation of light, heat, and electricity belong to a later stage.

"In a school-garden the boy becomes aware, almost imperceptibly, of the conditions of growth of a plant, of its dependence on light, air, warmth, water, and soil. He learns to see the relation of the various organs of a plant to each other as a living whole, and the connection between plant and insect life. It is not the dead anatomy of the laboratory that is his first introduction to nature.

"The schoolmaster seems no longer to be merely keeping school when he is at work with the boys in the garden, and his wife teaching the girls to cook and sew; he seems to be head of a working family, where, besides reading and arithmetic, the scholars learn to respect work and to perform it, to work together for a common cause, to understand the dependence of one upon another, to be helpful and to be grateful to each other. There arises among fellow labourers in all kinds of handwork a feeling of friendliness which does not easily arise over mere book work."

While the Commissioners were in Frankfort an exhibition was in progress at the Palmengarten, and it must be admitted that the flowers and fruit exhibited bore testimony to an astonishing degree of excellence in the horticulture and fruit-culture. Similar evidence of excellence was witnessed in Belgium, also in California: and it may be said that the agricultural exhibitions of this State also bear testimony to the practical value of scientific agriculture. The feature of modern agriculture is, that it is being more and more widely recognised that scientific agriculture pays better.

28. *Education of Teachers for Agricultural Instruction in Elementary Schools.*—The authorities in Germany offer facilities for, and exhibit a practical sympathy with, all attempts on the part of elementary teachers to qualify themselves to give elementary instruction in agriculture. In some of the training colleges the equipment admits of agricultural instruction being effectively given. The course is usually from two to three weeks in spring, and somewhat under a fortnight in autumn; cost of living and travelling expenses being allowed by the State to the teachers attending, and no charge being made against them for the instruction.

29.

[1] Loc. cit., pp. 385-6.

29. *Agricultural Education in relation to Industry.*—Though perhaps hardly within the proper scope of a report on education, it may, nevertheless, be remarked that the relation of agricultural education to associated industries is worthy of note.

Justus von Liebig, in his treatise published in 1840 on "The application of Organic Chemistry to Agriculture and Physiology," defined the chemical principles of scientific agriculture somewhat as follows:—

(*a*) Soils are satisfactory for the growth of crops when they contain all the necessary constituents.

(*b*) Every crop impoverishes soil by depriving it of certain constituents, depending on the nature of the crop.

(*c*) To maintain the fertility of the soil unimpaired it is necessary that the constituents removed should be restored by natural or artificial means.

(*d*) This restoration is in part effected by supplying natural and artificial manures.

(*e*) Animal manures are deficient, and if used must be supplemented by artificial manures.

(*f*) The bio-chemical effect of animal manures appears when fertilisers containing their important constituents are employed.

The above may be summed up in the statement that the supply of manure to the soil should be such as to maintain in sufficient quantity all the chemical substances necessary to the satisfactory development of the crops intended to be grown. To this need be added merely the statement that the soil should contain further, the necessary micro-organisms (nitrifying organisms, etc.), and, therefore, that the bacteriological as well as the chemical question must be taken into account in scientifically directed agriculture.

30. *General Conclusions.*—Agricultural education throughout Germany is in a very satisfactory condition, inasmuch as it meets the needs of *all* classes concerned, and provides instruction suitable to all grades of persons occupied in agricultural pursuits. The instructors are men of sufficient education and practical experience, and the results on agricultural industry give abundant evidence of the national value of the instruction.

CHAPTER XLI.

Agricultural Instruction in the Netherlands, Belgium, etc.

[G. H. KNIBBS.]

1. *General Scheme of Dutch Agricultural Education.*[1]—Agriculture in the Netherlands is taught:—

I. *By the State.* II. *By the Provincial Agricultural and Horticultural Societies, with the pecuniary assistance of the State.*

The State establishments are:—

(1.) The Agricultural College (Rijkslandbouwschool) at *Wageningen.*
(2.) The Agricultural and Horticultural Winter-schools (Rijkslandbouwwinterscholen and Rijkstuinbouwwinterscholen).
(3.) The Veterinary College ('s Rijksveeartsenijschool) at *Utrecht.*
(4.) Instructors of Agriculture and of Horticulture are also appointed by the Government in the various provinces, to give instruction in their respective subjects (Rijkslandbouwleeraren and Rijkstuinbouwleeraren).

In all matters relating to agricultural education, the Government is advised and assisted by an officer bearing the title of "Inspecteur van het Middelbaar Onderwijs, belast met het toezicht op de landbouwscholen" (Inspector of Secondary Education in charge of agricultural schools).

2. *System of the College at Wageningen.*—The State Agricultural College at Wageningen consists of four sections, viz.:—

(a) The Agricultural School (Afdeeling Landbouwschool).
(b) The Horticultural School (Afdeeling Tuinbouwschool).
(c) The High School (Afdeeling Hoogereburgerschool).
(d) The High School for Agriculture and Forestry.

The first and second sections (a) and (b) are two-year courses. No special examination is required for the admission of students who have previously attended the one-year preparatory class of the College.

The first section (a) is intended for future farmers in the Netherlands. A one-year colonial class (Indische Klasse) is added for students who desire to go out—as assistants or managers of sugar, coffee, tea, and other plantations—to the Colonies (*Java*), and who require, in addition, an elementary knowledge of colonial agriculture, laws, and customs.

At the second section (b) (*the Horticultural School*), future gardeners and growers are technically and practically educated. Students who desire a more scientific horticultural training should follow the two-years' continued course of this section.

The High Class School (3rd section, c) has a course of four years, preparatory to the fourth section, viz., *the High School for Agriculture and Forestry* (d). This last consists of:—

(1.) A two-years' course on "*Agriculture in the Netherlands.*"
(2). A two-years' course on "*Agriculture in the Colonies.*"

To the latter is added a two-years' course on "*Colonial Forestry*" for colonial foresters.

This fourth section (d) has also a course on "*Forestry in the Netherlands,*" which is open to all who have previously successfully passed either (i) any of the State High Class Schools (Rijkshoogereburgerscholen); or (ii) the division (c) at Wageningen; and who, moreover, can submit a certificate of having, for at least one year, occupied themselves with practical forestry.

A programme of lessons for each of the aforesaid four sections is hereinafter given.

A fee of 40 florins per annum, about £3 8s. 4d., is paid by each student. The classes begin on the first Monday in September, and are continued until 15th July of the following year, with a short holiday at Christmas and Easter.

The College, and, in fact, all agricultural instruction, is under the Department of Waterstaat, Commerce and Industry, and is directed by a Board of Directors ("College van directeuren") consisting of the directors of the four sections. The Board appoints one of its members as secretary; one of the other members is appointed by the Government as president of the Board with the title of "Hoofddirecteur" (*i.e.*, Chief Director), and acts as its executive officer. The total number of professors and teachers of various kinds amounts to about 40; the average number of pupils per annum is about 250. The annual expenses of the college amount to over fl.100,000 for salaries, and about fl.75,000 for general expenses—about £8,542 and £6,406 respectively.

3.

[1] For this part of the chapter the Commissioners are specially indebted to the Netherlands Government for the very kind preparation of a memorandum on Agricultural Education (by the Agricultural Department of the Ministry of Waterstaat, Industry, and Commerce.) They are also greatly indebted to His Majesty's Representative, Sir Henry Howard, for his very kind offices and representations to the Netherlands Government.

3. *The Programme at Wageningen Agricultural School.*—The following gives a fairly good indication of the programme of the courses in agriculture at the Wageningen College:—

State Agricultural College at Wageningen.

Section Agricultural School.—Section (a).

Preparatory Class.

Subjects.	Hours per week.
Mathematics[1]	6
Natural Philosophy	2
Geography	3
History	2
Dutch	4
German	4
French	4
Drawing	3
Caligraphy	1
Gymnastics	2
	31

First and Second Class.

Subjects.	I Class—Hours per week.	II Class—Hours per week. Before Easter.	II Class—Hours per week. After Easter.
Mathematics	4	2	2
Natural Philosophy and Meteorology	2	2	2
Chemistry	2	2	2
Botany and Zoology	2	2	2
Anatomy and Physiology of Domestic Animals	...	2	2
State Organisation and Political Economy	...	2	2
Geography	2	...	...
Dutch	3	2	2
German	3	1	1
French[2]	2	2	2
English[2]	3	3	2
Drawing	2	2	2
Gymnastics	2	...	...
Cultivation, Fields and Meadows	4	5	5
Cattle-breeding, Dairying	3	3	3
Economy and Book-keeping	1[3]	2	2
Ailments of Domestic Animals	...	2	2
Cultivation, Fruit-trees	1	1	1
Cultivation, Trees	...	1	1
Land Surveying and Levelling	...	1	2 pr.
	33 or 34	33 or 34	32 +2 pr.

Colonial Class.

Subjects.	Hours per week. Before Easter.	Hours per week. After Easter.
Mathematics	2	...
Natural Philosophy and Meteorology	2	2 +2 pr.[4]
Chemistry	3 +3 pr.	3 +3 pr.
Natural History	2	2
Double Book-keeping	1	1
English or German	1	1
Rural Economy and Ethnology	1	1
State Organisation of the East Indies	1	1
Javanese and Oral Language of Malay	4	3
Drawing	3	3
Land Surveying and Levelling	3	6
Highland Culture	3	3
Lowland Culture	3	4
	28 +3 pr.	23 +5 pr.

[1] To this must be added two hours weekly written work, under supervision.
[2] A choice must be made between French and English.
[3] After Easter, one hour elementary book-keeping.
[4] "pr." denotes Practical instruction, *i.e.*, field-work.

4. *The Horticultural School, Wageningen.*—The programme of the Horticultural-school section (b) is as follows:—

Subjects.	Class I. i.	Class I. ii.	Class I. iii.	Class II. i.	Class II. ii.	Class II. iii.
Botany	2	2	3	2	2	3
Phyto-geography	...	...	...	1	1	1
Cultivation of Flowers	3	4	5	3	4	5
Forestry and Arboriculture	1	1	1	1	1	1
Cultivation of Fruit-trees	1	2	3	2	3	3
Market Gardening	2	3	4	2	3	4
Drawing	4	4	8	4	4	8
French	2	2	...	2	2	...
German	2	2	...	2	2	...
English	3	3	...	3	3	...
Latin and Terminology	1	1	...	...	...	...
Chemistry	2	2	1	2[1]	2[1]	2[1]
Theory of Fertilizers	...	...	...	1	1	1
Natural Philosophy	1	1	...	2	1	...
Mathematics	1	1	...	1	1	...
Entomology (useful and injurious insects)	1	1	...	1	1	...
Book-keeping and Economy	1	1	...	1	1	...
Practical Instruction	14	14	20+24	14	14	20+24
Totals	41	43	45+24	44	46	48+24

[1] With two hours' practice every fortnight.

Class I, II { i. Winter half-year, September till March.
ii. Second half-year A, 1st February–15th May.
iii. Second half-year B, 15th May—the end of course.

Continued

Continued Course.

Subjects.	Classes and Hours per Week.	
	I.	II.
Botany	2[1]	2[1]
Phyto-geography	1	1
Cultivation of Flowers	2	2
Forestry and Arboriculture	2	2
Market Gardening	2	2
Drawing	2	2
Architectural Drawing; Design of Gardens, etc....	2	2
Geology, Soils, etc.	1	1
Chemistry	6[2]	6[2]
Theory of Fertilizers...	......	1
Meteorology	......	1
Natural Philosophy	2	2
Phyto-pathology	2	2
Practical instruction	4	4
Total	24 + 4 to 6 hours.[3]	25 + 4 to 6 hours.

[1] With from four to six hours' practical microscopy.
[2] With laboratory practice.
[3] Practical microscopy.

5. *The High School Agricultural Programme.*—The programme of the higher burgher-school, viz., of section (c), is as follows :—

Subjects.	Classes and Hours per Week.			
	I.	II.	III.	IV.
Mathematics	6	6 }	8	9
Mechanics...	......	...... }		
Natural Philosophy and Cosmography	......	1[1]	4	5
Chemistry	......	......	3	3+2pr.
Botany and Zoology	2	2	2	2
Mineralogy and Geology...	......	......	......	1
State Organisation	......	......	......	2
Book-keeping	......	......	......	1
History	3	2	2	2
Geography...	3	......	1	1
Dutch	4	3	3	......
French	4	4	2	2
German	4	4	2	2
English	......	4	3	2
Drawing	4	4	2	2
Gymnastics	2	2	2	......
Total	32	33	33	34

[1] To begin on the 1st of March.

6.

6. *High School for Agriculture and Forestry.*—The programme of section (d), viz., the High School for Agriculture and Forestry, consists, first (1), of a two-years' course on "Agriculture in the Netherlands," and of the first and second class on "Forestry in the Netherlands," the subjects of which are as follows:—

Subjects.	I Class—Hours per week.		II Class—Hours per week.	
	Before Easter.	After Easter.	Before Easter.	After Easter.
Natural Philosophy ...	1	1	1	1
Meteorology ...	1	1		
Chemistry ...	2+4	2+4	1	1
Botany ...	3	3	2+2 pr.	2+2 pr
Anatomy and Physiology of Domestic Animals ...	2	2	2	2
Useful and Injurious Animals ...	1	1	1	1
Mineralogy and Geology ...	1	1	......	......
Political Economy ...	2	2	2	2
Drawing ...	2	2	2	2
Phytology ...	2	2	2	2
The Soils in the Netherlands ...	......	......	1	......
Working of the Soil ...	......	......	1	1
Amelioration of the Soil ...	1	......	2	2
Land Surveying ...	2	3 pr.	1	3 pr.
Agricultural Chemistry ...	3	3	1+2 pr.	1+2 pr.
Agricultural Machines ...	3	2	2	2
Technology ...	......	1	......	......
Cattle-breeding ...	2	2	2	2
Dairying ...	1	1	1	1
Ailments of Domestic Animals ...	......	......	2	2
Book-keeping ...	1	1	2	2
Economy ...	1	1	3	3
Cultivation of Fruit-trees and Market-gardening ...	1	......	......	2 pr.
Forestry and Arboriculture ...	......	1	......	......
Totals ...	32+4	29+7	32+4	29+9

N.B.—The lessons marked as 1, 2, etc., are those of the courses on "Forestry in the Netherlands."

The second part of the programme is (2) a course of "Agriculture in the Colonies," which is as follows:—

Subjects.	Classes and Hours per week.	
	I.	II.
Natural Philosophy ...	1	2 1 c
Meteorology ...	1	c
Chemistry ...	2+4 pr.	... c
Botany ...	3 c	4 s
Anatomy and Physiology ...	1	... s
Useful and Injurious Animals ...	1	1[1]s
Mineralogy and Geology ...	1	1 s
Political Economy ...	2	2 c
Laws of Trade ...	......	2[1]s
State Institutions in the East Indies ...	1	1 s
Rural Economy: Ethnology... ...	1	... s
Javanese and Malay Oral Language ...	1	2 s
Drawing ...	2	2 c
General Cultivation of Plants ...	2	... c
Working in the Soil... ...	......	1 s
Improvement of Soil... ...	......	2 c
Highland Culture ...	2	2 s
Land Surveying and Levelling ...	2[2]	1[2]c
Agricultural Machines ...	3 c	1 s
Lowland Culture ...	2	3 s
Agricultural Chemistry ...	3	1+2 pr. c
Technology (sugar) ...	......	1 s
Cattle-breeding ...	1	... s
Book-keeping ...	......	2 s
Totals ...	32+4 pr.	32+2 pr.

[1] Till Easter.
[2] After Easter the practical instruction is three hours a week.
c Denotes that the classes are combined with those for "Agriculture in the Netherlands."
s Denotes that they are separate; where not otherwise indicated the classes are together.

The

The third part of the programme is the course on Forestry (colonial and home), and this course is also attended by the students of the course on "Forestry in the Netherlands."

Subjects.	Year I.			Year II.		
	i.	ii.	iii.	i.	ii.	i.
Mathematics	1	...	...	1	...	...
Geometry...	2	...	...	1	...	...
Geology	...	1	1	...	1	1
Drawing	4	...	...	4	...	...
Botany	...	1	...	...	1	1
(ditto)	...	...	3	...	...	3
Zoology	2	...	...	...	...	...
Meteorology	1	...	...	...	...	...
Javanese language	...	...	3	...	...	3
Forestry, soils, plants, tree cultivation, forest exploration ...	4	...	...	3	...	...
Timber measurement, wood-rent accounts	3	...	...	3	...	...
Colonial administration of Forestry	...	...	...	...	...	1
History of Forestry	1	...	...	2	...	...
Technology of cultivation—						
(a) Theory...	2	...	...	...	...	...
(b) Application	...	1	...	...	...	...
Pisciculture—						
(a) Theory...	...	1	...	...	1	...
(b) Application	...	...	...	...	...	2
Totals...	20	4	7	14	7	9

By (i) is denoted the combined part of the course; (ii) that for the Netherlands only; (iii) that for the Colonies only.

This completes the outline of the course at Wageningen. The course is of an eminently practical character, but has the requisite scientific foundation, and is taught by thoroughly qualified teachers, *i.e.*, by professors who are specialists in their several subjects.

7. *State Agricultural and Horticultural Winter Schools* (Rijkslandbouwwinterscholen and Rijkstuinbouwwinterscholen).—State Agricultural winter-schools have been founded at the following places in Holland in the years indicated, viz.:—

Groningen—	Province of	Groningen	1893
Goes	„	Zeeland	1893
Sittard	„	Limburg	1895
Dordrecht	„	Zuidholland	1896
Schagen	„	Noordholland	1896
Leeuwarden	„	Friesland...	1897

The State Horticultural winter-schools are at the undermentioned places, and were founded in the years 1896 to 1898.

Naaldwijk—	Province of	Zuidholland	1896
Aalsmeer	„	Noordholland	1897
Tiel	„	Gelderland	1897
Boskoop	„	Zuidholland	1898

At all these schools the course is two years, but the lessons are given during the winter months only, viz., from October to April, the pupils returning for the summer to practical work at the farms and homesteads of their parents. The schools have been established in order to give the farmers of the future, the horticulturists and foresters, the necessary technical knowledge that they will inevitably need in later life.

The minimum age of admission is 16 (with special permission 15), and a certificate of practical agricultural (or horticultural, as the case may be), as well as of elementary knowledge, is compulsory.

Inasmuch as no special director has been appointed, these schools are managed by the State agricultural, or State horticultural instructor, *vide* I (4) in section 1 of this chapter. At the agricultural winter-schools, however, a second permanent teacher and veterinary surgeon are also appointed. Dairying is taught by the provincial expert (zuivelconsulent), *vide* II, section 1.

The

The programmes of the two schools are as follows:—

Agricultural Winter Schools.			Horticultural Winter Schools.		
Subjects.	Class and Hours per week. I.	II.	Subjects.	Class and Hours per week. I.	II.
Geology, Soil Improvement	2	2	Market-gardening	2	2
Theory of Fertilisers...	2	2	Fruit-growing	2	2
Phytology	2	2	Tree-growing	2	2
Cattle-breeding	5	5	Nursery (flowers)	2	2
Cattle-feeding...	1	1	Theory of Fertilisers	1	1
Dairying	1	2	Book-keeping	1	2
Economy	0	2	Chemistry	2	1
Book-keeping	0	1	Physics	2	2
Chemistry	2	2	Botany	2	2
Zoology	2	2	Zoology	1	1
Dutch Grammar	2	0	German or English Commercial Correspondence	2	2
Arithmetic	2	1	Dutch Grammar	2	2
Botany...	2	1	Arithmetic	1	1
Physics...	2	1			
Totals	25	24	Totals	22	22

From these programmes only an average impression can be gathered, since the programme for each school is subject to individual alteration, according to the peculiar kinds of agriculture and horticulture obtaining in the district.

A sum of about 1,000 fl. (about £85) is put at the Director's disposal by the Government for equipments, accessories for experimental and demonstration purposes, administration, etc.

The school-building is provided for by the local municipal authorities.

8. *The Utrecht Veterinary College.*—The State Veterinary College at Utrecht is a training school for veterinary surgeons, etc. The course is four years. The programme of studies is as follows:—

1st Year.

Theoretical.

Winter Course—Natural philosophy.
Inorganic chemistry.
Zoology; anatomy.

Summer Course—Natural philosophy.
Inorganic chemistry.
Geology and mineralogy.
Botany; natural history.
Domestic and other animals.
Anatomy.

Practical.

Winter Course—Anatomy.
Hoof-shoeing.
Pharmaceutics.

Summer Course—Anatomy.
Horse-shoeing.
Pharmaceutics.
Botany.

2nd Year.

Theoretical.

Winter Course—Anatomy.
Histology and physiology.
Organic chemistry.
Physics.
Pharmaceutics.

Summer Course—Anatomy.
Histology and physiology.
Organic chemistry.
Feeding, therapeutic and poisonous plants.
The hoof and hoof-shoeing.
Doctrines of health.
Cattle-breeding.
Pharmaceutics.

Practical.

Winter Course—Anatomy.
Horse-shoeing.
Pharmaceutics.
Botany.
Chemistry.

Summer Course—Anatomy.
Horse-shoeing.
Pharmaceutics.
Botany.
Chemistry.
Microscopy.

3rd Year.

Theoretical.

Winter Course—General pathology and pathological anatomy.
Obstetrics.

Summer Course—General therapeutics.
Special pathology and pathological anatomy.
Theory of operating, surgery.
Theory of therapeutical agents and poisons.
Obstetrics.
The ailments of the hoof.

Practical.

Winter Course—Anatomy; hoof-shoeing.
Microscopy; clinic.
Surgical operations and dressing of wounds.
Obstetrics; treatment of sick animals.
External applications.
Pharmaceutics.

Summer Course—Clinic.
Surgical operations and dressing of wounds.
Obstetrics.
Treatment of sick animals.

4th

4th Year.

Theoretical.		Practical.	
Winter Course—	Special pathology. Pathological anatomy. Surgery. Theory of operations. Theory of therapeutical agents and poisons.	Winter Course—	Clinic. Surgical operations and dressing of wounds. The race of domestic animals. Feeding; treatment of sick animals.
Summer Course—	Judicial veterinary practice. Veterinary police. Inspection of meat. History and literature of the veterinary art. History of epizootic illness.	Summer Course—	Clinic. Surgical operations and dressing of wounds. Treatment of sick animals. Inspection of meat. Pharmaceutics.

The Veterinary College is under the administration of the "Department of Waterstaat, Commerce, and Industry," and is managed by a Director and a Council of Administration, consisting of the various teachers of the College. The Director is chairman of the council and, if appointed as a teacher, is also a general member of the Council. The Council appoints one of its members as its secretary, who as such remains in office for one year only.

The age for admission is 17 years. Future pupils must write distinctly, and successfully pass an examination in the following subjects, viz.:—

(a) The elements of Dutch grammar.
(b) The elements of French and German, so far as to be able to translate at sight from either of these languages into Dutch.
(c) The elements of geography.
(d) The elements of national and universal history.
(e) Arithmetic, and algebra with equations of more than one unknown equations of the 2nd degree. Arithmetical and geometrical progression, and practical work with logarithms.
(f) Geometry and planimetry. Furthermore, it is expected that the candidate, if not acquainted with the whole compass of the determination of areas and cubature of solids, may be able to make use of the principal formulæ, for the solution of rectangular and oblique-angled plane triangles, and to calculate surfaces and volumes of prisms, pyramids, cones, cylinders, spheres, and the spherical segment and sector.

The yearly contribution for each pupil is Fl. 100, about £8 10s.

At the end of each school-year an examination is held by the teachers, under presidency of the Director, of students of the first and third class, before their admission respectively to the second and fourth class.

The third class is open only to students, who have successfully passed the examination in natural philosophy (natuurkundig examen), held every year by the Director and the teachers; this embraces the subjects taught in the first and second classes combined, the examination in natural philosophy may, therefore, be considered as an examination for the passing from the second to the third class.

The so-called veterinary examination (veeartsenijkundig examen) held by a commission *ad hoc*, embraces the subjects taught in the third and fourth class, and may be considered as the final examination.

Students, who wish to enter for the veterinary examination, must have previously succeeded at the examination in natural philosophy, and hold, besides, a testimonial from the Director of the Veterinary College, or from a veterinary surgeon, to the effect that he (the bearer) has practised, during at least two years, the medical and surgical treatment of sick animals, and that he has assisted at least at ten deliveries of big cattle (horse and cow) in presence of a veterinary doctor, and has personally attended to at least two extraordinary (*i.e.*, complicated) deliveries.

The successful passing of the veterinary examination is followed by the issue of the diploma of "Veterinary Surgeon." And, as a rule, the right of professionally exercising the veterinary art (*i.e.*, the right to give professional medical and surgical advice and assistance) is allowed only to those who possess the aforesaid diploma.

For obstetric attendance on cattle and the performance of surgical operations thereupon, no diploma, however, is required.

Those who, by examination, have passed and are fully qualified to practice in another country, can by special permission be qualified also to practice in the Netherlands.

9. *Instructors in Agriculture and Horticulture appointed by the Dutch Government* (Rijkslandbouwleeraren and Rijkstuinbouwleeraren.)—In each of the eleven provinces a State-instructor in *Agriculture* has been appointed. In Noordbrabant, on account of its extent, two such instructors have been appointed.

State-instructors of horticulture have so far been appointed in only eight provinces, viz., at

Boskoop,	for the province of	Zuidholland.
Alkmaar	,,	Noordholland.
Tiel	,,	Gelderland.
Sittard	,,	Limburg.
Leewarden	,,	Friesland and Groningen.
Breda	,,	Noordbrabant and Zeeland.

Through the appointment of these instructors an opportunity is afforded to all farmers and gardeners to obtain gratuitously the technical and practical information by which the difficulties and problems experienced at their farms, gardens, and nurseries, are solved.

Besides

Besides this current work, lectures on agricultural and horticultural subjects are delivered during the winter months by these officers, wherever expedient. They further superintend the courses given by various private societies, and themselves hold courses for future teachers of elementary agricultural knowledge.

The aforesaid agricultural instructors in Zeeland, Limburg, Noordholland, and Friesland are at the same time directors of the agricultural winter schools in their district, situated respectively in Goes, Sittard, Schagen, Dordrecht, and Leeuwarden. For the State agricultural winter-school at Groningen and the horticultural winter-schools at Aalsmeer and Naaldwijik, a special director has been appointed. The other State horticultural winter-schools, viz., at Boskoop and Tiel, are governed by the horticultural instructors of those districts, viz., those of Zuidholland and Gelderland.

At each State agricultural winter-school there is a small experimenting field for practical and demonstration purposes; while for practical instruction at the State horticultural-schools, ample opportunity is afforded by extensive private gardens, for which government subsidies are annually granted of Fl. 1,500 each (about £128).

The State agricultural and horticultural instructors also make the plans, superintend, and send in reports concerning the experiments, which are carried out in every province, in order to shew the farmers how, by means of scientific cultivation and the use of chemical fertilisers, etc., the production of the soil can be greatly increased.

10. *Agriculture taught by the Provincial Agricultural and Horticultural Societies, with pecuniary assistance from the State.*—Among the teaching by various private societies, mention must be made in the first place of the agricultural and horticultural winter-sessions. In the winter, 1901–1902, no less than 141 of the latter were held throughout the country, by the local societies.

These courses in these sessions are given by teachers, possessing the diploma for elementary instruction in agriculture or horticulture. They last from October till April, the required schoolroom being put at the disposal of the sessions by the municipality.

As a rule, the sessions are for two years, and consist of one class only, so that only every second year can fresh pupils be admitted. The average programme, which is adapted to local requirements, is as follows:—

Winter Courses.

Agricultural.			Horticultural.		
Subjects.	Weekly.		Subjects.	Weekly.	
	I Year.	II Year.		I Year.	II Year.
Geology	1	...	Geology	1	...
Phytology	2	1	Botany	1	1
Physics	2	1	Theory of Fertilisers	2	
Cattle-breeding	1	2	Market-gardening	1	2
Cultivation and Soil Improvement	...	1	Fruit-growing	1	1
Theory of Fertilisers	...	1	Nursing of Flowers	...	2
Total hours	6	6	Total hours	6	6

At some sessions the number of lessons weekly amounts to eight, and besides a couple of practical lessons or excursions are usually made in summer.

The average subsidy granted by the Government for each session amounts to fl.250 per year, about £43.

In the next place may be mentioned the courses for adults on fruit-growing; on the anatomical knowledge of horses and cattle; on horse-shoeing; on poultry breeding; on agriculture, etc., which, provided the programme and the appointed teachers can meet with approval, are financially supported by the Government. Finally, may be mentioned the experts on dairying in every province, who are generally appointed by the agricultural society in the provinces, and whose work, with regard to improving the manufacture of butter and cheese, can be compared with the work done for agricultural and horticultural improvements by the instructors referred to in I. (4) in section.

A brief sketch on "Agricultural Education in the Netherlands," by Mr. J. C. Medd, and dated April, 1902, will be found in the Supplement to Volume VIII of the "Special Reports on Educational Subjects," published by the Board of Education, London, *vide*, pp. 58–62. The present state of the provision for agricultural education in Holland, and its thorough and elaborate organisation, are due to the inspiration and untiring energy of Dr. Sickesz, sometime Director-General of Agriculture. The State expenditure for the year totals over fl.491,000, or say about £42,000. The distribution of the agricultural schools is such as to meet the needs of the different agricultural communities, and to promote their industry in the best possible way. They practically bring the best instruction to the very doors of the people. Apparatus, diagrams, and models are liberally supplied for these schools. Mr. Medd mentions that about the village where the school of Naaldwijk is situated, there are no less than 1,000 market-gardeners engaged in profitable trade. Some idea of the cultivation of this district may be had when it is mentioned, that in one of the vineyards there are 62 varieties of grapes, and in the orchards there are about 700 different varieties of peaches, pears, apricots, and apples. A considerable amount of experiment is carried on with chemical fertilisers.

11.

11. *Outline of Belgian Agricultural Education.*—Agricultural education in Belgium dates from 1849, but was definitely organised, however, only in 1860. It is now given in establishments of the following kinds, viz. :—

(a) An agricultural institute giving higher education, viz., of the University type.
(b) A school of veterinary medicine.
(c) Three types of middle schools for theoretical and practical instruction in agriculture and horticulture.
(d) Elementary courses in agriculture, in a certain number of middle schools established in rural localities.
(e) Free middle or communal agricultural schools, subsidised by the State.
(f) Theoretical and practical agricultural courses, organised in some of the primary normal schools.
(g) Courses for adults ; special conferences ; dairying,—schools, courses in fruit-tree culture, kitchen-gardening, apiculture, poultry-keeping, and farriery ; and finally—
(h) Courses in agronomy for soldiers, constituting a sort of elementary education in the subject.

12. *The Institut Agricole of Gembloux.*—The theoretical instruction provided in the "State Agricultural Institute of Gembloux," embraces the following subjects :—

(A) Rural engineering.
(B) The physical and mathematical sciences.
(C) Natural history.
(D) Zootechnics.
(E) Cultivation or agriculture.
(F) Rural economy and the economics of forestry.
(G) Rural law.
(H) Agricultural book-keeping.

The practical instruction embraces the applications of the preceding courses on a farm of about 69 hectares (170 acres). The length of the most complete course was originally three years, but now a fourth year has been added of a special character. The site of the institute has been admirably chosen, right in the heart of the country, in the midst of an agricultural centre, and in the midst also of associated industries. The fine buildings are those of the old Abbey of Gembloux.

The declared aim of the Belgian Government in founding the institute, was to afford the necessary scientific knowledge, and by having under review a practical and rational agriculture, to so react upon the proprietors or managers of farming properties, that their operations shall be both intelligent and lucrative. Distributed over the whole country, the graduates will become the apostles of agricultural progress, the propagators of new ideas based on scientific knowledge. They will also be competent to direct the agricultural industries which are now rising into prominence, such as sugar-growing, distillery, manufacture of fertilisers, etc. The developments from 1861 to 1900 were—

Years	1861.	1862.	1870.	1880.	1890.	1900.
Pupils	11	31	61	83	117	104

In view of the significance of the microscope in modern scientific research, microscopy was added to the course in 1875. In 1883 the experimental garden and farm were organised.

In 1890–1 a new chemical laboratory was added, to admit of a larger number of pupils working together. In 1891 a special chair was created for instruction in the botanical sciences, zoology, and entomology ; and in the following year a course of hydrology was joined to that of mineralogy and geology.

The fourth year in the course was added in 1897, and the work divided into three sections, viz. :—

(i) Woods and forests (eaux et forêts).[1]
(ii) Chemistry and agricultural industries.
(iii) Agronomy and agronomic teaching.

These sections are for those who are already possessed of the diploma of agricultural engineer (ingénieur agricole), and are designed to specialise and complete their knowledge of *scientific forestry*, chemistry, and agricultural industries ; or to prepare them as instructors in the agronomic sciences. Experience has shewn that good results have flowed from the addition of this year.

Since the foundation of the institute, and up to the 31st December, 1900, the graduates in agricultural engineering have been occupied as indicated in the following statistical table, viz. :—

Proprietors, farmers, or farm-managers	125
Teachers, foresters, etc.	82
Occupied in agronomic stations and laboratories	24
In agricultural and non-agricultural industries	150
In commerce, variously, and deceased	94
Total	475

A

[1] This implies the care of forests, for example, the "Maitre des eaux et forêts" is our "forest-ranger."

A better idea of the details of the occupation of the graduates in agricultural engineering can be had from the statistical results up to 31st December, 1899 :—

Proprietary cultivators	61
Farmers	15
Farm-managers	19
Teachers	27
Agronomic stations and laboratories	19
Agricultural industries	94
Non-agricultural industries...	34
Commerce (agricultural machines, fertilisers, various commercial occupations)...	55
Total	324

At the institute's farm all the progressive changes involved in the development of agricultural science are exhibited. Its large areas are splendidly managed, its work in all branches embodying the latest improvements.

For the electric lighting and electric current required in the place, and for the treatment of 2,500 litres (say 550 gallons of milk) per hour, it has a steam-engine of 50 horse-power. A portable electric motor, for cereal-threshing and for other general farm-work, is part of the equipment. This last is utilised to demonstrate the various possible applications of electricity.

On the occasion of the Commissioners' visit, M. Hubert, the Director, was away; but M. Th. Dieudonné very courteously shewed the Commissioners through the institute, which obviously is an agricultural university. The illustration hereunder gives some idea of the main building; and, besides this, there are several detached buildings. The experimental farm immediately adjoins.

AGRICULTURAL INSTITUTE OF GEMBLOUX, BELGIUM.

13. *Administrative and Teaching-staff of the Gembloux Institute.*—In order to indicate the highly specialised character of the teaching of this Agricultural Institute, it is necessary to shew how well it is staffed,—for teaching has value only in proportion as it is excellent in quality, and this excellence is attained by employing highly-skilled teachers, *i.e.*, specialists. And it may be pointed out that a syllabus must be taken not alone, but in conjunction with the calibre of the teaching personnel.

The following is the staff at Gembloux :—

1. *The Director* (M. C. Hubert).

Professors in Ordinary—

1. Agriculture. 2. Rural Engineering. 3. Forestry. 4. Physics and General Chemistry. 5. Botanical Science. 6. Analytical Chemistry and Zoology.

Honorary Professor—

1. The Director of the Chemical and Bacteriological Institute (State). Food adulterations.

Extraordinary Professors—

1. Zootechnics. 2. Mineralogy.

Supernumerary

Supernumerary Professors (Agrégés)—

1. Rural Economy. 2. Rural Law and Political and Social Economy. 3. General Mechanics and Rural Construction. 4. Agricultural Technology.

Lecturers, Demonstrators, etc.—

1. Agricultural and Industrial Book-keeping, by a professional accountant. 2. Methodology and Forestry-pathology, by an assistant. 3. Practical Forestry, by the Inspector of Woods and Forests (*eaux et forêts*). 4. Drawing, in charge of an architect. 5. Assistant in Physics and Chemistry. 6 and 7. Two Garden-demonstrators. 8. Librarian and Usher. 9. Curator of the Museums, and Usher. 10. Secretary and Usher. 11. Manager.

It will be seen that there are fourteen professors, all experts, on the teaching-staff of the Institute, and eleven others, who also in their lines are highly qualified. There are assistants besides these.

14. *Conditions of Admission.*—Candidates who are are not otherwise qualified, must, in order to be admitted to the Courses in the Institute, obtain at least 50 per cent. in an examination in each of the following groups of subjects:—

(1) *French Language.*—Reading, grammar, orthography, style, literary analysis. If Flemish be taken, the examination is divided into two similar groups. (Both languages are spoken in Belgium.)

(2) *Arithmetic.*—The whole range, including square and cube roots, progressions, and logarithms.
Algebra.—Elementary algebra, including algrebraical calculation, the resolution of operations involving the first and second degree only, and questions of maxima and minima.
Geometry.—Geometry of two and three dimensions (the eight books of Legendre) with the problems and applications in the manual.
Trigonometry.—Plane trigonometry.

(3) *History.*—Principal facts of general history, including ancient, medieval, modern, and contemporaneous history. Belgians must also pass in Belgian history.

(4) *Geography.*—Mathematical geography, physical and political geography of Europe. General geography of other parts of the world. Belgium for Belgians only.

(5) *Physics.*—General properties of matter, gravity, hydrostatics, pneumatics, and acoustics.

The examination is partly oral and partly written.

The minimum age of admission is 17 years. To obtain the diploma of Agricultural Engineer the course is three years. Unsuccessful pupils may not follow the same course more than twice. Pupils may be either resident or non-resident: the latter easily find lodging in the adjoining village. The cost of residence is 700 francs per year for Belgians, and 1,000 francs for foreigners, say, £28 and £40 This includes fees for the instruction. For non-residential pupils the fees are 300 and 400 francs respectively, say, £12 and £16. In addition to this the pupils pay at the beginning of each scholastic year 20 francs to cover the cost of breakages, etc., and in part the cost of the laboratory expenses.

15. *The Course of Studies in the Gembloux Institute.*—In explanation of the curricula in the various years, it may be said that the instruction is divided, as in Holland, into the theoretical and practical sections. The following are the programmes for the three years' course, ending in the diploma:—

1st Year.

Theoretical.

Rural engineering; general mechanics.
Plan-drawing; surveying.
Physics and meteorology.
General chemistry.
Qualitative analytical chemistry.
Mineralogy.
Botany; morphology; anatomy; systematic.
Zoology, general and comparative; entomology; apiculture.
Zootechnics; descriptive and comparative anatomy.
General agriculture.

Practical.

Rural engineering; plan-drawing.
Surveying; applic. of mechanics.
Applications of physics.
General chemistry; chemical manipulations.
Qual. analyt. chemistry; characters of the various salts.
Practical exercises in mineralogy.
Botany; botanical microscopy.
Field botany.
Zoology; practical comparative anatomy; entomologic excursions.
Zootechnics; demonstrations upon anatomical specimens
Exercises in cultivation.
Drawing.

2nd Year.

Theoretical.

Rural engineering; hydraulics; agricultural instruments and machines; levelling; drainage.
Chemistry; continuation of qualitative.
Geology, general; comparative study of soils; hydrology.
Botany; vegetable physiology; bacteriology; vegetable pathology; geographical botany.
Zootechnics; animal physiology; hygiene.
Pathology of contagious diseases; sanitary police.
General agriculture.
Forestry; essential principles of tree-planting, economic and ornamental; natural and artificial reafforestation.
Rural law.
Political and social economy.

Practical.

Rural engineering; applications relating to levelling and hydraulics.
Chemistry, qualitative analysis.
Geology; geologic excursions.
Botany; microscopy; applications of physiology, bacteriology, and vegetable pathology.
Zootechnics; applications of hygiene and physiology.
General agriculture; cultivation.
Forestry, practical.
Drawing.

3rd

3rd Year.

Theoretical.	*Practical.*
Rural engineering; steam-engines; irrigation; rural building.	Rural engineering; practical exercises in irrigation, and with the steam-engine.
Agricultural technology.	Agric. technology } Analyses of various
Chemistry; quantitative analysis.	Quantitative analysis } agricultural materials.
Zootechnics; feeding, producing, breeding, improving, and use of domestic animals.	Zootechnics. Rationing and using domestic animals.
Agriculture; special crops for temperate and tropical regions.	
Rural economy.	Rural economy; farm service.
Forestry; cultivation, treatment, protection, and exploitation of forests.	Forestry; practical measurement.
Agricultural book-keeping.	Drawing.

It has been found desirable to divide, as mentioned in section 12 of this chapter, a fourth year of special study into three sections. These are as follows:—

(i) *Woods and Forests.*

Forestry.

Special botany; vegetable pathology in connection with forestry.

Special zoology; entomology in relation to forestry.

Pisciculture.

Applications of mathematics to forestry questions.

Special geology and hydrology.

Forestry legislation, and offences in connection therewith.

Practical discussions.

Excursions, etc.

(ii) *Chemistry and Agricultural Industries.*

Technology—Sugar-refinery, distillery, brewery, chemical fertilisers.

Quantitative chemical analysis.

Building—Design of sugar-refineries, distilleries, breweries, etc.; consideration of the strength of materials; industrial drawing.

Electricity as a motive power and as a source of light.

Steam-engines, gas-engines, and petroleum-engines.

Industrial bacteriology; industrial legislation; industrial accountancy.

Food analysis; laboratory work; excursions.

(iii) *Agronomy and Teaching Section.*

The elements of psychology and logic in their relation to education; ethics.

Constitutional law.

Methodology applied to the agricultural sciences.

Horticulture, arboriculture, fruit-growing, and kitchen-gardening.

In addition a special study must be made of one of the following subjects:—

Agronomy; rural economy; political economy; zootechnics; botany; zoology; geology chemistry and technology; rural engineering.

16. *Detail of the Study.*—The above courses are done very thoroughly. In order to give something like a definite idea of the degree of detail in which each subject is taken, it is necessary to follow a programme *in extenso*. We, therefore, indicate the nature of the the development. It will be sufficient to take merely a few cases as illustrating the whole. The course in physics includes preliminary ideas, hydrostatics, pneumatics, theory of heat including thermodynamics, optics including spectroscopy, magnetism, static and dynamic electricity. Taking the two last subjects by way of illustration, they are treated as follows:—

Static electricity.—Fundamental phænomona. Theories of the electric state. Distribution of electricity. Potential and electric capacity. Electrification by influence. Condensation of electricity. Electro-static machines. Effects of condensers and of electric machines.

Dynamic electricity—Hydro-electric and thermo-electric piles. Laws of electric currents. Electro-magnetic units. Chemical effects of currents. Polarisation of electrodes. Accumulators. Mutual actions between currents. Action of currents on magnetic needles. Magnetisation by currents. Electro-magnets and their application. Electro-dynamic induction. Induction apparatus. Applications of induced currents. Magneto- and dynamo-electric machines. Electric motors. Physiological, thermal, and luminous effects of electric currents.

As

As a second example one may take the organic chemistry of the first year.

Organic chemistry.—Composition of organic bodies. Analysis. Determination of the formula. Classification of organic substances.

Fatty series.—Carbides of hydrogen. Saturated mono-atomic alcohols. Mercaptans. Ethereal salts, simple, mixed, and compound. Aldehydes. Fatty acids. Sulphonic acids. Anhydrides. Amines. Amides of the fatty acids. Diatomic, triatomic, tetratomic, pentatomic, and hexatomic alcohols and their derivatives. Non-saturated monatomic alcohols. Carbohydrates. Pectic substances.

Aromatic series.—Aromatic carbides. Phenols, alcohols, aldehydes, aromatic acids and amines. Azo-compounds. Naphthalene and anthracene groups. Pyridine and quinoline bases. Vegetable alkaloids. Terpenes. Camphors. Albuminoid substances.

The practical work consists of the setting-up of the ordinary apparatus of a laboratory for organic chemistry, and the preparation of the principal substances.

The work in hydraulics in the second year will serve for a third and final example.

Hydraulics.—Velocity of flow of liquids. Torricelli's formula. Adjutages. Flow over weirs, etc. In pipes and channels. Various forms of apparatus for measuring the velocity of flowing water. Different processes of gauging.

As far as could be judged in the very short time that the Commissioners had at their disposal, the scheme of agricultural teaching is of the highest character, both from the practical and theoretical point of view.

17. *State School of Veterinary Medicine.*—The "école de médecine vétérinaire de l'état" was founded in Brussels in 1832, and out of 1,652 students who have entered the school since the beginning 1,062 have obtained the diploma. The education is also of the University type.

18. *Secondary Agricultural Education.*—The object of the three types of secondary agricultural schools is to give sound professional instruction to the sons of farmers and small proprietors, with a view to creating in them a love for the calling of their parents, and, in this way, *contributing to the development of the national prosperity.* This instruction has, therefore, an immediate practical end, and consequently the professor aims at giving his pupils such ideas as are susceptible of direct application. He continually demonstrates the practical application of the scientific principles which he teaches. These schools have programmes, as follows:—Highest grade of secondary agricultural teaching, 3 years' studies. Second and lowest grades are each two years. The teaching here also is of a very high character as the programmes shew.

Secondary agricultural education, highest grade.

1st Year.

I. *General natural science.* (A) *Chemical properties of bodies.*—Nomenclature; study of simple bodies and of inorganic combinations which have agricultural interest; laboratory exercises, setting up of apparatus, etc.; preparations.

(B) *Physics, mechanics, and meteorology.*—General properties of material bodies; motion, forces, levers, etc.; weight and density; hydrostatics, pneumatics; applications, and manipulation of instruments.

(C) *Agricultural zoology.*—Classification, and succinct description of the higher and lower animals, useful or noxious from the point of view of agriculture; practical exercises in descriptive zoology; entomologic excursions.

(D) *Botany and microscopy.*—Organography; anatomy; physiology; practical exercises.

II. *Natural science applied to the cultivation of plant-life. Agrology; Agronomy.*—Origin of arable lands, properties of soils, amelioration, improvement, drainage, irrigation; practical exercises; excursions.

III. *Natural science applied to the rearing of animals.*—Anatomy and physiology of the domestic animals; skeleton, muscles, nerves; respiratory apparatus, apparatus for the circulation, for nutrition, etc.

2nd Year.

I. (A) *Organic chemistry.*—Analysis by the dry method; qualitative analysis by the wet method laboratory practice.

(B) *Physics and meteorology.*—Mechanical theory of heat; electricity; agricultural meteorology; manipulation of instruments, meteorological observations.

(C) *Special botany.*—Study of vegetable families important from the point of view of agriculture; diseases of plants; exercises; herborisations.

(D) *Mineralogy and geology.*—Study of mineral substances having relation to agriculture; beds of nitrates, potash salts, phosphates; geological map of Belgium.

II. (A) *Agronomy.*—Agricultural instruments, and work; sowing; tending crops; harvesting; conservation of the harvest; ensilage; rural constructions.

(B) *Agricultural chemistry and physiology.*—Composition of the plant; rôle of the leaves, of the roots; development of plants; laws of restoration, and of fertilising the soil; experiments; excursions.

III. (A) *Physiology of domestic animals.*—Origin of animal heat, and of mechanical work; movements, paces, direction.

(B) *Zootechnics.*—Description of the principal races of domestic animals; crossing, inbreeding, appearance, quality, age, description; hygiene, housing, feeding, watering, and drinking, etc.; condiments; farriery, work, harness, etc.; exercises and excursions.

IV. *Rural economy.* (A) *Factors in production.*—Land, capital, work; agricultural crisis, causes of same; agricultural speculation, combination; cultivation on a large and small scale; exchanges, contracts, etc.; problems of rural economy; excursions.

(B) *Commerce and legislation.*—Contracts of sale and lease; commercial transactions; law in regard to the adulteration of chemical fertilizers; rural law (code rural).

3rd Year.

I. *Chemistry.*—Quantitative analysis of the principal agricultural substances; laboratory work.

II. (A) *Agronomic excursions.*

(B) *Agricultural chemistry and physiology* in continuation of the course of the second year.—Selection; the special physiology of the different agricultural plants; laws of the rotation of crops and experimental researches on vegetation; excursions.

(C) *Special cultivations.*—Particular care for each cultivated plant; period of sowing, etc.; varieties; diseases and remedies; aboricultural principles in relation to fruit-tree growing and forestry; orchards; exercises and excursions; kitchen-gardening.

III. (A) *Rational feeding of domestic animals.*—General principles, special feeding of each species; practical exercises upon the composition of the feed.

(B) *Dairy.*—Special feeding of milch cows; rational treatment of the milk; manufacture of butter and cheese.

(C) *Agriculture and pisciculture.*

IV. (A) *Agricultural accountancy.*—Book-keeping in single and double entry; exercises.

(B) *Agricultural industries.*—Milling, distillery, brewery, sugar-refinery, starch-manufacture, fecula, etc.; chemical fertilizers.

The programmes of the second and lowest grades are of a very similar type, but are, of course, much simpler, in view of the fact that in order to cover the course in two years, the work had to be restricted. It will be seen that in the regular schools of agriculture there are, therefore, four distinct grades of teaching, viz., from the University type downward. By this means the Belgian Government is able to further the agricultural interests of practically all classes in the community, whatever their intelligence.

19. *Secondary Agricultural and Horticultural Schools in Belgium.*—The following are the schools substantially of the type indicated in the preceding section:—

(1) Agricultural school at Nieuport, (2) Thielt, (3) Hasselt, (4) La Louvière, (5) Leuze, (6) Sottegem, (7) Grammont, (8) Avelghem, (9) Dinant, (10) Chimay, (11) Carlsbourg, (12) Virton, (13) Waremme. (14) School of practical agriculture at Huy. (15) School of agriculture and horticulture at Ghent. (16) Practical middle school of agriculture and horticulture at Vilvorde.

The only one of these schools inspected by the Commissioners was the lastmentioned, viz., that at Vilvorde, not many miles from Brussels. The Director, M. Bouillot, very kindly placed himself at the Commissioners' disposal, and explained the practical and theoretical work done in the institution. The scientific equipment is, of course, on a scale not at all comparable to that of the agricultural university at Gembloux; nevertheless, it is excellent in its way, and is adequate for the purpose of instruction in physics, chemistry, botany, mineralogy, etc., for the class of pupils who frequent the institution. These, of course, intend to become practical gardeners and agriculturists of a high character, but do not aim at becoming scientific men of the highest order. The experimental garden and orchard, and the vineyards, were in themselves good evidence of the efficiency of the practical teaching. The Commissioners saw hundreds of varieties of various fruit-trees, and the grapes were some of the finest seen during their whole tour. The teachers, as far as the Commissioners were able to judge, combine practical ability and sterling practical tendencies with high appreciation of the service which agricultural science is able to render to practical agriculture. The teachers in these institutions are specialists in their departments of knowledge.

20. *Schools of Agricultural Management in Belgium.*—Another class of agricultural school seen by the Commissioners was the "école ménagère agricole." These exist at—

(1) Héverlé.	(4) Bouchout.	(7) Overyssche.
(2) Herve.	(5) Virton.	(8) Bastogne.
(3) Brugelette.	(6) Gysegem.	(9) Oosterloo.

The only one of these visited by the Commissioners was the "Ecole ménagère-professionnelle-agricole" at Héverlé-Louvain in connection with the "Institut du Sacré-Coeur et de L'Immaculée Conception." This institute embraces altogether the following:—

(1) A higher agricultural school.
(2) A professional and commercial school.
(3) A professional house-keeping school.
(4) A secondary school with a preparatory section.

The courses are given by professors and engineers of the Agronomical Institute of the Catholic University and by mistresses possessing the State diploma. The studies are for two years. Besides recapitulation lessons on modern languages (Flemish, French, English, German), the programme embraces mathematical and commercial sciences and a sufficiently developed course on physics, general chemistry, agricultural chemistry, dairying, cheese-making, bacteriology, zootechnics, poultry-raising, apiculture, botany, agriculture, kitchen-gardening, arboriculture, zoology, geology, rural engineering, pædagogy, domestic economy, hygiene, needle-work, drawing, and social rural economy.

The

The school is recognised by the Government, and after an official examination pupils obtain the diploma of the higher agricultural school. Besides the higher school there is a secondary agricultural section in which the studies last only a year. In this section the programme is that of the "*écoles ménagères-agricoles*," but is, perhaps, a little more developed; and pupils, after passing an official examination, obtain the diploma of such schools. Pupils are practically instructed in the agricultural installation of the institute under the direction of diplomaed mistresses.

The scientific and agricultural equipment was very good. There is the usual physical and chemical laboratory, and the dairying and cheese-making laboratories were fitted up with Laval, Mélotte, Persoons, and other cream-separators, and with proper appliances for cheese-making. They have their own steam-engine plant, and heating furnace, in this department of the institute. In the agricultural museums there are museum-specimens of the different methods of budding, grafting, etc. The institute has a fully equipped bakery plant. The lower section aims at qualifying girls of the middle class, so that they shall become equipped as intelligent working-farmers' wives, thoroughly conversant with the methods of baking bread, able to deal with household and farm duties, competent to look after farm animals, and to develope the ordinary farm-products, butter, cheese, etc. It was the intention of the institute, also, to create a branch for the agricultural education of girls of good family, so that they also may take an intelligent interest in the management and development of landed estates, and be able to control operations of an agricultural or farming character.

There can be no doubt that schools of the above type tend to considerably raise the average intelligence, and in a practical way. Although they do not make pupils scientific investigators, they do make them appreciative of the service that agricultural science can render, and, moreover, they teach how to observe and to distinguish their needs. The great value of their courses is that with even an aperçu only of any given branch of the science, it is practically impossible to ignore the real requirements of rational agriculture. The habit of methodical observation is established, and also the disposition to methodically analyse the observed facts in the light of at least an intelligent conception of the probable requirements of the case.

21. *Programme in the Agricultural Sections of Secondary Schools.*—The special agricultural instruction is given in the second and third years of the course of the secondary schools, the programme for the first year being the same for all sections. Attention is specially called to the very practical character of this teaching, as also to its comprehensiveness. The general course consists of the following subjects, viz.:—

Religion; the mother-tongue; a second obligatory language; an optional third language; geography; Belgian history; mathematics; natural science; hygiene; book-keeping; music, and gymnatics. Excluding the optional language and music, 21 hours per week are given to these subjects. In addition, the special course involves extra time to the extent indicated in the following table:—

Special course for Agricultural Sections.	Year 1.	Year 2.
I. Applications of geometry to agriculture ...	...	1
II. Elements of agronomy and of practical zootechnics	3	3
III. Fruit-tree growing and cultivation of herbs	1	1
IV. Agricultural book-keeping ...	1	1
V. Drawing	2	2
VI. Manual work	3	3
Total number of hours per week	31	32

This total does not include the third language and the music. The details of these subjects are as follows:—

I. (a) *Surveying.*—Exercises on the ground; measurement of the area of plots; plan-drawing; division of properties; orientation; conventional signs and tints; cadastral survey, and cadastral plans; fixing of boundaries.

(b) *Quantity measurement.*—Various kinds; masonry; ditches; embankments; trenches, etc.; cask gauging; timber-measurement.

(c) *Levelling.*—Operations in the field.

(d) *Drainage and irrigation.*—Studies and plans.

II. A. (a) *Soil and subsoil.*—Formation of arable land; constitutive and nutritive elements; suitable experiments to demonstrate the physical properties of earth; porosity, cohesion, capillarity, etc.; lightening the soil, its advantages; different kinds of soil; argillaceous, sandy, calcareous, mould; physical analysis of the soil; separation of the clay, of the humus; research as to the acidity of the soil; experiments to shew the absorbent power of ground, for water and fertilising materials; a word upon meteorological influences.

(b) *Working of the soil.*—Spade, hoe, etc.; trenching; plough, "double brabant," subsoil plough, etc.; description, rules and qualities of good ordinary ploughing.

(c) *Work.*—The course refers to the various kinds of work in the field, superficial and deep, and the special precautions to be taken, the function of harrowing and rolling, the conditions of good work.

(d) *Seed.*—Qualities of good seed; usual methods of determining the germinating power; precautions to be taken in purchasing seed; its liming; selection of the grains.

(e) *Sowing.*—Time for sowing; sowing by hand and by machines; advantages of the latter; quantity and depth of setting.

(f) *Keeping in order.*—Digging in, weeding, heaping up.

(g) *Harvesting and hay-making.*—Favourable time; instruments; conservation of agricultural products; stacks, barns, silos.

B. (a) *Care of domestic animals.*—Housing; hygienic conditions; causes of the alteration of the air; aeration of stables, poultry-yards, piggeries, dairies, etc.; best temperature for these places, suitable degree of humidity in the air; the hygrometer.

(b) *Care.*—Function and structure of the skin of animals; beneficial effects of proper bedding, of frequent baths, and of a daily grooming.

(c) *Poisoning through plants;* flatulency; inoculation and prevention of diseases; summary precautions against epizootic diseases; services of veterinaries.

C. *Injurious insects.*—Principal facts concerning insects injurious to plants; destruction of caterpillars and other injurious insects.

D. *Cryptogamic diseases.*—Proper methods of destroying; caries of seed-grains; the peronospores of the potato; the oïdium and mildew of the grape.

The above gives a sufficient indication of the thoroughness of the programme in the first year's work. It will be sufficient to give merely the headings of the second year's work in agriculture. The instruction consists of:—

(a) *The fattening of animals and the fertilisation of the soil,* and deals with the necessity of restoring to the soil the elements taken from it by particular crops, and the restoration by chemical or other manures. The subjects are, of course, rationally treated, and include experiments.

(b) *Drainage* and its effects.

(c) *Suitable water,* the proper time and the effect of irrigation, and the supply of fertilising sewage by way of irrigation.

(d) *Natural and artificial pasturages,* their care, and the principal forage plants.

(e) *Special culture,* the principal cereals, the potato and one or two local industrial plants.

(f) Principal rules of *rotation of crops,* with special attention to the local peculiarities.

(g) Rational appreciation of the particular type of *cultivation* near the locality of the school.

(h) The *feeding of animals,* based upon a description and the functions of the digestive apparatus of domestic animals; upon the part played by the different elements in their food, viz., by mineral substances, by the carbo-hydrates, by nitrogenous and by fatty substances; the theory of waste and repair and work, including the consideration of the great importance of regular feeding, of the horse, milch cow, etc.

(i) The effect of hot and cold *drinks* upon the animal economy is indicated; the character of drinkable water; the means of improving impure waters, as, for example, by aeration, boiling, filtration, and various other methods; the question of the proper temperature is also considered.

(j) The *qualities of good milking cows;* the composition of milk; the circumstances which modify its richness; the question of its cream-product; of the production of butter and cheese; and that of milk-supply, are all treated.

(k) The best *breeds of poultry* are referred to, and the means of incubation and rearing.

(l) The Professor of Agronomy, as opportunity offers, indicates various applications of arithmetic to agricultural calculation. He gives the solution of problems relating to the improvement of the soil; to the expenses of management and of hand-labour; purchases of seeds; to the harvesting; the making of an orchard; the product of the dairy, of the piggery, and of the poultry-yard; and similarly he deals with the question of the purchase and use of commercial fertilisers; of the food-value of the various kinds of forage; of the feeding of animals and their value to the carcase-butcher; and of the net product of any given type of cultivation.

Each of the remaining subjects, viz., III to VI, referred to in this section, are dealt with in the same comprehensive and thoroughly methodical manner, and it will be sufficient to give merely a running outline of the work in each section.

First, in regard to III. In the first year of the Special Course the methods adopted in fruit-tree nurseries are fully outlined, and the question of transplantation of the young trees to the orchards, etc., and of the special care to be given them at the time and afterwards, is fully treated. In dealing with the pruning of trees special attention is given to the pear and apple, the peach, and the grape-vine. The making and care of orchards, the guarding against diseases of the trees, and against injurious insects, the proper methods of collecting and conserving the fruit, conclude the first year's course of instruction.

The second year is devoted to the consideration of practical work in the garden, of the cultivation of pot-herbs, particular attention being given to the cultivation and conservation of the most useful vegetables, and to the care of seeds.

Secondly, in regard to IV, viz., Agricultural accountancy. The necessity of a thorough system of agricultural book-keeping is explained, and a special study is made on the basis of an elementary-treatise on the subject by Minet.[1] The students learn to keep a set of books, to make out an inventory, to copy letters, and the general practical work of an office; and in the second year, beside recapitulation of the first year's course, they are shewn how to keep the books of a fairly large farm.

Thirdly, in regard to Drawing (*i.e.*, V). Linear drawing with instruments, and drawing in relief, which constitute the programme for the first special year, are identical with the work done in the secondary general schools in the corresponding years. In the second year of the special course, the fundamental ideas of orthogonal projection and free perspective are treated as in the third year of the general secondary school. In addition, technical drawing is learned. This includes conventional signs and tints, technical sketches of side-elevations, tinted and annotated; sketches in orthogonal projection and free perspective of any given objects; and topographical drawing. In selecting the objects, those which have applications in agriculture are naturally preferred.

Fourthly,

[1] Traité élémentaire pratique de comptabilité agricole, by Hilarion Minet. The book is for sale by the author of Leers-Fosteau, near Thuin (Hainaut), Belgium.

Fourthly, with regard to VI, viz., Manual work. In the first year, after learning the uses of various carpentering tools, practical work is undertaken, conformable to a list of exercises and models as arranged by the teacher. The second year is simply an advancement upon the first year's work, with the introduction of some new tools.

Throughout these courses the instruction is given, not by one or two men who teach everything, but by teachers specially competent in each department.

22. *Courses in Agronomy for Adults.*—In regard to lower agricultural education, there are a number of courses in agriculture, agronomy, etc., for adults. These are much in vogue, and have been given since 1887. They are well organised in all the rural communes. Attendance at them is very regular, and the value of the courses is greatly appreciated. Many defective practices have been uprooted, and the whole of the agricultural work has been put on a more rational basis. The agricultural population of Belgium has undoubtedly learned to value the splendid services which scientific knowledge can render to agricultural practice; and in this country at least it has been abundantly demonstrated that farms can be more economically and more profitably worked when a scientific method is followed.

The Agronomy courses are organised each year upon general propositions formulated by the agronomists of the State. Each course occupies 15 lessons, the groups of which are as follows:—

Group.	Subject of instruction.
1.	General conceptions of agriculture.
2.	The rational feeding of cattle.
3.	Zootechnics and hygiene.
4.	The rational treatment of milk, butter, and cheese.
5.	Agricultural book-keeping and accountancy.
6.	The raising of poultry.
7.	Rural law.
8.	Elementary conceptions of rural economy.
9.	Mutuality and co-operation.
10.	Agricultural hydraulics.

The sub-heads of the first group are as follows:—Definition of agriculture and the law of agricultural production. The soil and subsoil; mechanical work on the soil; tilling; natural and artificial pasturage; seed; germination; sowing; tending the crop; harvesting and hay-making; fertilisation of the soil; control of fertilisers and of seeds; the service of analytical laboratories; the agronomical service of the State, and agricultural instruction.

The second group, as far as the division of the subject is concerned, follows pretty much the line of paragraphs (h), (i), (j) of II, D in section 20 of this chapter.

The third group treats of the function of the skin of animals, the beneficial influence of proper bedding, of frequent bathing, and of daily grooming. The effect of the temperature of the stables in regard to any given end; stables for fattening merely; methods of disinfection; the hygiene of gestation and parturition; the laws of reproduction; methods of rearing; hereditary vices; improvement of the breed by crossing and selection; the methods of recognising in young animals special aptitude; the handling, purchasing, and sale of animals; the provincial regulations upon the improvement of the breed of cattle, are among the subjects treated. In addition to the above, the following matters are also discussed:—Legislation on those vices of domestic animals which render a sale null and void; inspection of foods, its double rôle; sanitary police for domestic animals; regulations concerning bovine tuberculosis; preventive vaccination against anthrax and other diseases; injections for tuberculosis and glanders; regulations concerning the branding of cattle, its utility.

In the fourth group the care of milk, the manufacture of butter and cheese, and everything related thereto, are considered.

In the fifth group everything connected with the accountancy of agricultural undertakings; with the study of the various forms of agricultural merchandise; with commercial operations and banking; and with the profit and loss account of the farm, is methodically treated.

The sixth group is concerned with the various breeds of fowls; the installation of a fowl-yard; with natural and artificial incubation; with the natural and artificial raising of chickens; the fattening of poultry; with the symptoms of their diseases; with preventive means and remedies; with the associated commerce; with poultry-raising societies, and similar things.

The subjects in the seventh group are:—The law of excavation; of cultivation; of harvesting; and concerning bees. The law concerning caterpillars: the clearing away of thistles; concerning injurious plants and insects generally, and the preservation of frogs. The law of irrigation; of drainage; of commonage; of closes; of inheritances; of distances of plantations; of delimitations of boundaries. Law of offences and penalties; of service, and of service standing in relation to particular places; of service established by law. Rights of property; contracts as to hiring and letting. Wages of workmen; mortgages; explanation of agricultural laws passed by the Legislature; sanitary police for domestic animals; vices which render the sale of animals null and void; laws concerning the adulteration of fertilisers, and of foods for cattle.

The eighth group treats of the following subjects:—The factors of production, viz., soil, capital, and work; agricultural crises and their causes; agricultural speculations and combinations; agriculture on large and small scales; relations subsisting between proprietors and farmers; contracts.

The ninth group treats of syndicates for the breeding of cattle, etc.; of co-operation; of societies for mutual insurance against mortality in cattle; of societies of mutual credit; and of societies for common sale or purchase.

The tenth section discusses drainage; impermeable subsoils; the elimination of an excess of water; the effect of excessive water as regards the quality of the ground, and upon vegetation; the practice of drainage; irrigation; proper kinds of water; proper times to irrigate; the effect upon herbage; the raising of land by alluvial deposit; sewage; the rural code in so far as it relates to irrigation and drainage of land, and to channels.

23. *Elementary Course in Agronomy for Soldiers.*—This course was tentatively commenced in 1890, and established in 1897 for soldiers of lower rank; and takes place in the months of December, January, February, and March. The necessary teaching accommodation is provided by the military authorities, but the cost of heating and lighting falls upon the "Department of Agriculture and Public Works." Every soldier who has made a request to the captain of his corps, before the opening of the course, is admitted thereto. The theoretical instruction comprises about 20 lessons, and is developed pretty much in the same way as the agronomical course for adults. The lecturers are always ready to explain matters of interest in connection with the course to the students attending it. The instruction is given either in French or Flemish. The teaching staff limit the practical instruction to excursions on Sundays with their pupils in the agricultural establishments of the neighbourhood. A prize and books are given by way of encouragement to pupils who distinguish themselves by their application.

24. *Courses in farriery.*—These courses were instituted in 1900, and comprise 10 lessons, the theoretical instruction being supplemented by practical demonstrations given at a forge in the locality. The programme is as follows:—

(a) Historical aperçu; utility of shoeing; the anatomy of the hoof, description of the internal parts thereof.
(b) Description of the horny part of the hoof, its wall, its sole, frog, etc.; differences between the two halves of the foot, differences between the front and rear part of the foot.
(c) Proportions of the foot, straightness, physiology of the feet, elasticity, nutrition.
(d) Ordinary shoeing, different parts of the ordinary shoe, difference between the two halves, and between the shoe of the fore-foot and hind-foot.
(e) Making the shoe; instruments for shoeing; preparation of the hoof to receive the shoe; advice on handling horses; racing shoes, hunting shoes.
(f) Criticism in regard to ordinary shoeing, and comparison with physiological shoeing; description of the principal physiological shoes, shoe of Lafosse, Poret, Charlier.
(g) Shoeing for ice; description of the principal systems, advantages and inconveniences of each of them.
(h) Corrective shoeing; faults of proportion, hoof too big, too little, faults of shape, foot straight, hoof-bound. Study of this last condition and of shoes therefor, retroverted heel, flat-foot, and other defects.
(i) False aplomb of the foot, crooked-leg, splay-foot, toe too low, club-foot, foot down on the internal quarter, on the external quarter, appropriate shoeing, faults of pacing.
(j) Pathological shoeing, protective shoeing, surgical shoeing, orthopædical shoeing, etc.; shoeing of the ass, mule, and bullock; aperçu of foreign shoeing.

25. *Course in Fruit-Tree Arboriculture and in Kitchen-Gardening.*—During the period 1896–1899, 280 courses in arboriculture were given, and these were attended by no less than 12,417 people; and also 120 courses in kitchen-gardening. These two courses are given in 15 lessons, the outlines of which are roughly as follows:—

Programme of the course in Arboriculture.

1st. *General considerations.*—Cultivation of fruit-trees, from the point of view of public food requirements and national wealth. The garden, its utility, and products; management of an orchard and herb-garden, preparation of the soil, fertilisation, and improvement.
2nd. *Notions of vegetable anatomy, organography, and physiology.*—Composition and structure of plant; elementary organs, organs for maintenance, and reproduction; their utility and functions.
3rd. *Natural and artificial multiplication of fruit-trees.*—Collection and preservation of seeds, mode of setting, care, sorting, and transplanting; cutting, layering, grafting, practical and thorough study of selection, and of the influence of the stocks used; regrafting of old trees, care after grafting.
4th. *Planting fruit-trees.*—Preparation and appropriation of ground for various kinds; trenching, draining, etc., manuring; selection of trees; transplantation, cutting and treatment of the roots; treatment of trees which have suffered in transportation from freezing or dryness; time for planting; size of trees for transplantation, care immediately after, manuring and annual labour.
5th. *Winter pruning.*—Pruning of trees, its aim and utility; various types of pruning, cutting of branches and complementary operations; incision, notching, bending, training; free and trained forms recommendable for trees in general, equilibrium between the aerial and subterranean parts of the tree; equilibrium between the branches, means of maintaining or of re-establishing it.
6th. *Cultivation and pruning of vines.*—Special consideration of multiplication and plantation; treatment of the vines and of the fruit-bearing shoots; restoration of exhausted or badly formed vines; renewal of the vines by grafting; establishment of shelters and of vine conservatories from the point of view of amateur and mercantile cultivation; care to be given to the fruit before, during, and after maturation; insects and diseases. *Cultivation and treatment of the raspberry.*
7th. *Cultivation and treatment of the pear.*—Special considerations upon the multiplication and plantation of this tree; examination and demonstration of its various branches; formation of the wood of free recommendable forms (pyramid and various other forms); choice of varieties for each form, and explanation. *Apple cultivation and pruning, various recommendable forms and varieties.*
8th. *Cultivation and pruning of the pear in espalier-forms.*—Advantages and establishment of various forms of espalier; pruning and treatment of the stem and fruit-bearing wood in the various modes of culture adopted for the pear; treatment of trees that fructify with difficulty; restoration of badly formed, diseased, or exhausted pear-trees, or of those giving mediocre fruit.

9th

9th. *Cultivation and pruning of the peach.*—Details concerning multiplication and plantation; various shelters and other means for protecting spring vegetation; espaliers; enumeration and demonstration as regards the various species; training of the various forms suitable to the climate; pruning of the fruit-bearing wood; consideration of particular methods of cultivation; restoration of old trees; diseases and insects; means of combating them by prevention of invasion.

It will perhaps be sufficient to give a general indication of the other lessons, after enumerating their titles.

10th. *Cultivation and pruning of the apricot, plum, cherry, and gooseberry.*
11th. *Fruit-trees in the open*, with high stems.
12th. *Generalities in regard to the orchard.*
13th. *Summer pruning.*
14th. *Further generalities of orchard-management.*
15th. *Packing, sending out and exportation, and similar matters.*

In treating these subjects, the part played by diseases and insects, by birds and other useful animals, by bees in fecundation; questions of commerce; of various modes of utilizing fruit, by drying, distillation, etc.; the whole question of grafting and budding, and the general economic management of an orchard, etc.; are all discussed in detail.

The *programme on the Course in Kitchen-gardening* in fifteen lessons, is equally full, and deals with the cultivation of all vegetables; of chicory, etc.; with the cryptogamic diseases and the means of combating them; with the processes of packing and transport; with the preparation of vegetables in canning and other methods of preserving them.

26. *Course in Apiculture.*—Increasing attention is given to the subject of Apiculture in Belgium, and the Government deems that instruction in the subject is necessary, and in consequence has multiplied this course in all parts of the Kingdom.

27. *Dairying Schools.*—The object of the dairying schools of Belgium is to qualify people to become good overseers of dairies, and to facilitate the rapid acquisition by the agricultural engineers, of practical dairying knowledge. Some of these schools are merely temporary. The teaching in the school of *Borsbeke* comprises:—

A course in dairying and cheese-making,	and practical work in connection therewith.
,, mechanics,	
,, zootechnics,	
,, book-keeping,	

At the end of the course, which lasts four months, an examination is held; in this marks are awarded for work during the course, and for the written and oral results at the examination. The course is for young men only.

In the dairying school at *Betecom*, where the instruction is also theoretical and practical, practical work is undertaken each day, commencing at 7 in the morning, and 6 in summer, and lasting till 11·30. Work in the dairy is from 7–9·30, and the pupils are divided into six groups, who are occupied as follows:—

(1.) Receive milk, measure, take samples, etc.
(2.) Attend to boiler, steam-engine, cream separator, pasteuriser, etc.
(3.) Attend to the control, viz., respecting the density of the milk, its richness in cream, in fatty matter, the acidity of the milk and of the cream.
(4.) Manufacture cheese.
(5.) Churn, and work up the butter.
(5.) Pack and despatch the butter.

From 10–11·30 is spent in cleaning the machines and the place, in making packing-cases, in setting-up and taking to pieces, and repairing the machines, steam-pipes, etc.

Theoretical lessons are given from 1–3 in the afternoon, and from 4–7 the students undertake their studies in the school under the superintendence of the professors. Pupils present reports of their work each week, and each month an examination is held. The school has a library, which is available to the pupils; this contains the periodicals concerning dairying, cheese-making, pastoral cultivation, the raising of cattle, etc.

The conditions of entrance are:—

(1.) The being at least 16 years of age, and possessing the physical aptitude to undertake the various kinds of work.
(2.) The possession of a good primary education, so as to be able to easily follow the theoretical lessons.
(3.) An engagement in writing to regularly follow the course, and undertake the necessary work for the proper working of the dairy.

The course is absolutely gratuitous.

In order to meet the falling-off in the dairy products, chiefly butter, and to cope with the rivalry of such countries as Denmark, and with the superior products obtained by the centrifugal separators, the Belgian Government deemed it necessary to afford instruction also to the young women of the kingdom. In Belgian farms, it may be noticed, the care of the stables and dairies, etc., falls largely on the women. It was necessary for them, therefore, to understand the rational feeding of animals, their hygiene, and also the management of the modern dairy. The first school of dairying for young women was organised at Soumagne in March, 1890. To-day each Belgian province possesses its dairying school, and these are much appreciated by the farmers, who can send their children to them for instruction without inconvenience, and without expense, since the schools are gratuitous.

These

These schools are in session for three or four months. The whole of the material is furnished by the Department of Agriculture, and the schools are established either in a farmhouse, or in any habitation that has a sufficient number of rooms for the proper installation, and the necessary cellars. For the butter-factory, the apparatus is composed of two or three separators, hand-machines, pasteurisers, refrigerators, improved churns, butter-mixers, control apparatus ("creamometer," "lactodensimeter," "lactobutyrometer," Victoria, Babcock, and Gerber controllers, "lactofermentators," etc.) for the cheese-making, tables, drainers, double-bottomed vats, presses, cheese-shapes or moulds, etc.; and finally all the necessary accessories for the making of butter and cheese.

The course is given on all working days, not less than 10 nor more than 16 pupils are accepted, it is, as above said, absolutely gratuitous, but the pupils must, if necessary, make their own arrangements as to board outside; two hours are devoted to theory, and three to practical work. The condition of admission is that the young women shall be at least 15 years of age; the other conditions are the same as for the young men.

The teaching staff consists of—

(1) A director, who is charged with the courses of agronomy and zootechnics, and is responsible for the entire material organisation of the school, the selection of the locality, the purchase of milk, sale of produce, etc.; he supervises the practical work, and controls the regular course of the work, the apparatus, instruments, etc., and all money matters. These duties can be undertaken only by the State agronomists.

(2) Two dairy mistresses, who reside at the school. They are charged with the course in dairying, cheese-making, and book-keeping, and they direct the practical work of the pupils.

The practical course is arranged as follows:—Each day 150 to 200 litres of milk are treated, part being converted into butter, part into cheese of the kinds locally the most suitable. All the pupils take part in each kind of work in turn, being divided into four groups, whose several duties are as hereunder:—

(1) Control of the milk and cream separation.
(2) Churning and preparation of the butter.
(3) Cheese-making, and its treatment in the drying-room and in the cellar.
(4) Cleaning the instruments, etc., and the place.

The change of duty is made weekly. The required milk is furnished by the people in the locality, or by the pupils' parents. The work is co-operative, and each supplier takes the products and sub-products due to him. The system has, as one of its chief aims, *the demonstration of the advantages of cooperative dairying.* Twice a week the farmers, etc., are invited to witness the operation of the establishment, and to take account of the advantages of the new systems.

Two hours daily are given to the theoretical course; it is made as intuitive and attractive as possible, by means of the material which the teaching staff is able to exhibit; for example, collections of fertilising materials, of seeds, diagrams, microscopes, herbarium material, etc. The pupils themselves make little collections of fertilisers, of oil-cake, of arable soils, and, as far as the season permits, of the gramineous, leguminous, and injurious plants to be found in the fields.

The theoretical studies are very varied, and relate to the principal ideas concerning good farming; for example, the choice and feeding of animals; the improvement of the fields; the use of fertilisers; the making milk, butter, cheese, etc.

The programme of instruction comprises:—*Dairying*, as hereunder—

(1) Description and composition of the milk; change; adulteration; description of instruments for determining the value of milk and for the detection of fraud; the creamometer, lactodensimeter, lactobutyrometer, centrifugal controller, acidimeter, filtration, aeration, pasteurisation, sterilisation, cooling, weighing and measuring.
(2) Installation of a dairy, locality, water, etc.
(3) Sale and transport of milk.
(4) Manufacture of butter, quality of milk to employ, separation of the cream, different systems and their explanation, cream, churning, washing, preservation, packing, sending away, utilisation of bye-products—skim-milk, thick milk, whey.
(5) Cheese-making—milk to be used, rennet, coagulation, theories of manufacture, of different kinds of cheese, of foreign cheeses.
(6) Advantages of cooperation in dairying.

The other subjects are—Zootechnics, pastoral agriculture, book-keeping; and the students have access to a *library*, which contains a fairly large number of treatises on dairying, butter and cheese making, the hygiene and feeding of cattle, forage cultivation, domestic economy, arboriculture, etc.

Zootechnics is treated as follows:—General conceptions of anatomy and physiology, organs of digestion, respiration, circulation, and secretion. The milch-cow—qualities of a good milker, various breeds, rational feeding, care of animals, treatment, parturition, hygiene, accidents, remedies within the reach of farmers.

In *Pastoral Agriculture* elementary notions as to soil and climate, pasturage, the flora, formation, care, fertilisation, irrigation, and drainage, etc., are all discussed. Also the choice, the rational production and conservation of forage; the creation of orchards, fruit-trees, and hedges.

In *accountancy*, the instruction is mainly directed to the system of bookkeeping actually necessary in the establishment itself. This, of course, fully illustrates the book-keeping of dairies.

An examination is held at the end of the session, when pupils who obtain 50 per cent. receive a certificate. The theoretical part consists of oral and written examinations; 25 marks are given for practical work, 50 for oral examination, and 5 each for the following subjects —dairying, cheese-making, book-keeping, agriculture, add zootechnics. Pupils who do not obtain 50 per cent. at the examination, may, nevertheless, if their practical work be good, receive a certificate in respect thereof. Something like 2,000 pupils have been diplomaed.

28. *Commercial Significance of the Dairying Schools of Belgium.*—The recent extension of the dairying industry in Belgium is undoubtedly largely due to the establishment of dairying schools. At the present time there are over 6,000 hand-separators, and about 400 large co-operative dairies, treating the milk produced on the farms of something like 25,000 cultivators. In 1890 Belgium imported for its own consumption something like 6,000,000 kilograms of butter; in 1899 the quantity had fallen to less than 1,000,000 kilograms. During the same period the quality of the butter produced vastly improved. The progress in cheese-manufacture has not been so remarkable, and in order to bring about a stronger realisation of the advantages of co-operative industry in this respect, a special school has been established, with a six months' course.

29. *State analytical laboratories.*—With a view of facilitating as much as possible the verification of the value of fertilising materials, of cattle-feed, of seeds, and similar things, supplied commercially; the Minister for Agriculture, in addition to having chemical laboratories immediately under his control, made arrangements through which the work of private laboratories could also be accepted in dealing with fraudulency in regard to fertilisers, etc. By the regulation of 29th November, 1895, the conditions which must be fulfilled by chemists in order to co-operate with the State, are defined. At Gembloux, alone, since 1872, no less than 67,215 analyses have been made up to the end of 1899, and up to the end of last year the total number of analyses for the whole of Belgium amounted to something like 370,000. The activity of the various State laboratories may be gathered from the following statistics of their total work up to the end of 1899:—

Laboratories ...	Gembloux.	Ghent.	Liege.	Hasselt.	Antwerp.	Mons.	Louvain.
Analyses ...	67,215	42,197	68,761	20,960	30,493	37,783	31,058

The total of these, 298,467, may be distributed as follows:—

Fertilising material	163,383	Seeds	1,032
Cattle feed of various kinds ...	10,460	Sugar beets, etc.	95,082
Food commodities	17,758	Various	10,752

Of this large total no less than 60,688 were analyses of fertilisers and cattle-foods, made at the instance of, and paid for by, the vendors.

30. *General Conclusions as to Dutch and Belgian Agricultural Education.*—It will be seen from the preceding programmes, that a very thorough endeavour is being made by the Governments of Holland and Belgium to place the results of scientific research at the disposal of the entire agricultural population. The thoroughly systematic and well elaborated scheme of instruction is adapted to the state of education and the industrial needs of the entire agricultural community; and the education is itself of such a character as to greatly raise the plane of general intelligence. It is vividly realised that the expenses of such establishments as these are more than repaid by the wealth accruing through the improvement of the agricultural industry. The teaching personnel is qualified by proper scientific training; and such qualification is really a factor of the highest importance in the whole issue. This method of bringing practical education to the very doors of the people, and of placing the teaching in the hands of men who are at once practically expert and well-trained theoretically, not only teaches the people the real value of scientific knowledge when it enters as a controlling factor in human industry, but it also makes them instinct with that respect for science which is necessary for the progress of its higher branches. It is this general realisation of the value of abstract science, apparently characteristic of the whole of Europe, that we stand in sore need of in this State. There can be no doubt whatever, from what the Commissioners witnessed during their tour in these two countries, viz., Holland and Belgium, that the State assistance in enabling the people to realise the value of the application of science to industry is more far-reaching and is on a much higher plane than here. It may also be observed that those governments in their scheme of primary education do not specialise it into mere agricultural knowledge. A good primary education is a necessary foundation for the proper appreciation of, and a profitable attendance upon, such a specialised course as that in agriculture. In the details of the system of teaching, the intuitive method is followed as far as that is possible; and the supply of apparatus and diagram is such as to make the course really efficient. The scientific elements of the teaching are, moreover, so designed as to awaken interest in their wider significance, while at the same time they are strongly directed to the practical ends in view. Time is never wasted on scientific matter, the scope of which lies outside the immediate purpose; this is easily achieved, because the instructors are highly qualified, both theoretically and practically, for the work assigned to them. Occasional lectures delivered in various parts of the country, however valuable they may be in themselves, are in no way comparable to the regular training, at once theoretical and practical, of the Dutch and Belgian schemes. This scientific and practical thoroughness, which expresses itself in the systematic way in which all Continental education is given, and in the appreciation of the value of a training in pure science, is the secret of continental success. The so-called "practical man," who plumes himself on his indifference to the higher and more abstract forms of scientific forms of scientific knowledge, and on the superior value of his practicability, is not in vogue as a practical teacher in Europe, and is known for what he really is. It ought again to be affirmed, that if agricultural industry and its allies is to rival that of the two countries before referred to, our educational and general traditions must be similar in respect of the offices of the highest branches of Agricultural Knowledge.

CHAPTER XLII.

CHAPTER XLII.

Agricultural Education in Austria, Bohemia, Denmark, Italy, Norway, Sweden.

[G. H. KNIBBS.]

1. *Introduction.*—It is proposed in this chapter to give a general indication of the provision made for agricultural education in several European countries without necessarily descending to details. This will serve to exhibit how wide-spread is the recognition of the necessity for such education, and how extensive is the provision made for it in Europe.

2. *Agricultural Education in Austria.*—Agricultural education in Austria may be divided into three grades, viz. :—

(I.) That afforded in high schools or universities, as at Vienna and Cracow (Kraków), where there are departments of agriculture, forestry, and agricultural technique, and an agricultural course, respectively.

(II.) That provided in higher schools (*Höhere Lehranstalten*) and middle schools (*Mittelschulen*), of which there are a considerable number.

(III.) That given in lower schools, viz., farming schools (*Ackerbauschulen*) and agricultural schools (*Landwirtschaftliche Schulen*). If we include forestry schools (*Forstlehranstalten*), viticulture and fruit-culture schools, and the brewing school at Vienna, there are 18 institutions of the second grade; and if we include farming schools, schools for fruit-culture and viticulture, and also agricultural winter schools, horticultural schools, dairying schools, and so on, there are about 150 schools of lower grade.

The languages of instruction are German, Polish, Czech, Magyar, Italian, Slovene, Ruthenian, Roumanian, and Servian-Croatian.

3. *Agricultural High School of Vienna.*—The High School, or University, for the culture of the soil (*Bodenkultur*) at Vienna has three courses of studies, viz., (1) The Agricultural course (*Landwirtschaftliche Studium*); (2) The forestry course (*Forstwirtschaftliche Studium*); and (3) The culture-technology course (*Kulturtechnische Studium*). It aims at giving scientific education of the first rank in forestry and agriculture. Originally under the Department of Agriculture, it was transferred in 1878 to the Department of Education, though the former Department has still some representation in its management, organisation, and professorial appointments. At the head of the Institution is a *Rector*, annually elected by the professors, the Department of Education, however, having the right of confirming the election or otherwise. For the three sections the staff consists of 17 regular professors; (*Ordentliche Professoren*); three special professors (*Ausserordentliche Professoren*); 13 honorary lecturers (*Honorierte Docenten*); 2 assistant lecturers (*Supplenten*); 6 lecturers (*Privat-Docenten*); 9 assistants, etc.; 2 teachers (*Lehrer*); in all 52, or about 1 teacher for 7 students as will be seen.

The students of the forestry section are more than double those of the agricultural section, while the agricultural-technology section is about a fourth of the latter. The total number of students is about 360.

Regular students must have passed their final examination at the Classical Gymnasium or the Higher Real School, but regular students of the Polytechnicum or Technical High School are also admitted. Irregular students must be at least 18 years of age.

Definite plans of studies are arranged by the professors for the three courses, but to follow these is not obligatory, and students may attend such courses and give such direction to their studies as they please. At the close of each semester they may be examined and receive progress certificates, from the several professors or lecturers whose courses they have attended. Public examinations are held by the State. In the agricultural-forestry sections there are three examinations and in the agricultural-technology section only two. The Examining Board is appointed by the Minister for Education, and consists of members of the University staff and persons not connected therewith.

Regular students who have completed the chief courses, viz., the series of studies practically agreeing with the plan recommended, may obtain diplomas on satisfactorily passing final examination.

The students are kept informed as to the progress of agricultural investigations by lectures and demonstrations, given by specialists and men engaged in practical agriculture. The scientific foundation and the necessary laboratory practice are provided in the high school itself.

4. *Agricultural Course in the Cracow University.*—About fifteen years ago a special agricultural course was established in the University of "Kraków." Regular students therein must have passed the final examination of the gymnasium, and be generally qualified for the courses of the University. The students of technical high schools, or those who have merely passed through schools of the type of the higher Real School, are accepted only as irregular students. The complete course lasts three years, and is definitely outlined. Those who wish to *graduate* in agriculture must strictly follow this course. A regular student of the course who has spent four years at the University, and who submits a satisfactory doctorate thesis on an agricultural subject, receives the degree of Doctor of Philosophy. The

The control of the details of the agricultural section of the University are relegated to a permanent body of professors of agriculture and of natural science, the chairman of this being the Director of the course, and his office lasting three years.

The teaching-staff consists of five regular professors, assistants and "*dozenten*," a number of professors in the philosophical faculty of which it forms a part, professors of law, a veterinary surgeon, and two teachers. Incidentally it may be mentioned that the teaching-staff of the Cracow University numbers 67 in the Philosophical Faculty and 161 in the four faculties, viz., theology, law, medicine, and philosophy.

This course and the course at Vienna are considered among the highest courses for agricultural technology in Austria.

5. *Other Advanced Agricultural Courses in Austria.*—The technical high schools in Austria have agricultural courses which, though not so completely developed as the preceding, are yet of a very high grade. They usually include, in addition to the natural sciences, mechanics, etc., very specially developed instruction in agricultural chemistry and agricultural technology. In some cases forestry forms a part of the course, in others it forms a complete section. There are technical universities (*Technische Hochschulen*) at Vienna, Graz, Prague (Czech,) Prague (German), Brünn, and Lemburg. The complete scientific equipments, and the range of the professional teaching power of these polytechnica, are a sufficient indication of the character of the teaching provided in any subject.

It may be mentioned that the equipments are sometimes very special. For example, in the Czech Polytechnic at Prague there is a special laboratory for the investigation of questions touching the production of beet-sugar. The features of this were noted by the Commissioners.

6. *The Secondary or Middle Grade of Agricultural Education.*—The secondary grade of *agricultural* education is to be found in the following schools, viz. :—In Lower Austria, at Mödling, in Bohemia; at Tetschen-Liebwerd and Tabor, where there are provincial schools of higher agriculture; and at Chrudim, Kaaden, Raudnitz-Hracholusk, where there are agricultural middle schools. In Mähren (Moravia), there are provincial agricultural middle schools, at Neutitschein and Prerau; in Silesia, there is a provincial agricultural middle school at Ober-Hermsdorf; at Galicia, there is a higher provincial agricultural school at Dublany and a provincial agricultural middle school at Czerniechów; in Bukowina, there is a provincial agricultural school at Czernowitz.

The second grade of *forestry* is to be found in the higher forestry institution of Weisswasser in Bohemia; in Mähren (Moravia), in the higher forestry institution of Weisskirchen[1]; in Galicia, in the provincial school for forestry of Lemberg.

Other forms of agricultural education are to be found in Klosterneuburg in the Œnological and Pomological Institution (*k. k. önologische und pomologische Lehranstalt*, viticulture and fruit-culture). At Eisgrub in Mähren there is a higher fruit-culture and horticultural school (*höhere Obst-und Gartenbauschule*).

Instruction relating to the agriculture connected with the production of brewing materials is also given in the Vienna "Academy of Brewing Industries" (*Akademie für Brauindustrie*).

7. *Scheme of Austrian Secondary Agricultural Education.*—In general, the secondary schools have three-year courses, and entrance as regular students of the school in some cases can take place only on the completion of the courses of the classical Gymnasium or of the Higher Real School, and in other cases on the completion of six classes.[2]

In most cases, where the preparation is not complete, applicants may enter by passing a somewhat severe entrance examination.

The instruction includes the natural sciences, language, history, geography, etc , and agriculture is thoroughly taught as a special subject.

Students completing the course and passing the final examination receive a diploma, and those that do not obtain diplomas receive certificates, provided their attendance and work has been generally satisfactory. The examination is both written and *viva voce.*

That the examination covers practical ground is evident from the fact that it embraces such subjects as the following :—

Agricultural chemistry and technology, the use of agricultural implements and machinery generally, the amelioration of soils, and use of fertilisers, etc., botany in its applications to agriculture, the breeding of animals, and the physiological basis thereof, the scope of industry, taxation, etc. Considerable attention is paid, not only to the fulness of information upon particular subjects, but also to their interrelation and interdependence.

8. *Austrian Secondary Education in Forestry.*— The secondary forestry Schools of Austria are (I) the *höhere Forstlehranstalt, Weisswasser in Böhmen*; (II) the *höhere Forstlehranstalt, Weisskirchen in Mähren* (Moravia); (III) the *Landeslehranstalt für Forstwirtschaft, Lemberg in Galizien.* This last is a State institution, the others are not. There is now, no doubt, another institution at *Bruck an der Mur* in Styria, about 34 miles north of Graz.

The course is three years, experience having decisively shewn that an earlier two-years course was inadequate.

The admission conditions are the lower stage (Class VI) of the Gymnasium or high "real" school, followed by one year actual practice in forestry.

The subjects are general and special, viz., natural science, mathematics, etc., and the professional matters appertaining to forestry.

The teaching-staff is organised in the ordinary manner, *i.e.*, there is a director, professors, lecturers (all specialists), and assistant teachers.

Diplomas are granted to those who pass the final examination.

9.

[1] Mähr. Weisskirchen höhere Forstlehranstalt.

[2] Reference may be made to the Commissioners' Report on Secondary Education, Chapter IX, pp. 105-117, for the significance of this.

9. *Secondary Schools for Fruit-culture, Viticulture, Horticulture, etc.*—The Moravian fruit-culture and horticulture school at Eisgrub (*höhere Obst-und Gartenbauschule*) originally simply a horticultural school, was opened in 1895 through the activity of a Vienna Society. The school is built in the domain of the Prince von Lichtenstein.

It aims at providing a thoroughly scientific and artistic education in all branches of horticulture and fruit-culture, to the end that its graduates shall be able (I) to apply the art of gardening under any variety of condition, (II) to develope kitchen gardens on any scale, (III) to direct or supervise the development of private or public gardens, (VI) to grow fruit on any scale required.

Only twenty students per annum can be received, and the course lasts three years. The condition of admission, in addition to the general educational qualification, is one years' apprenticeship in any larger horticulture establishment. The curriculum embraces general and special subjects, and practical exercises, great stress being laid on the latter. The extensive gardens of Prince von Lichtenstein offers an ideal field for experiment and practice.

The œnological and pomological school at Klosterneuburg is about 5½ miles N.W. of Vienna. It has a two years course, admission of regular students taking place after passing through a secondary school, and some practical experience of viticulture and fruit-culture. There are also special provisions for the admission of those who reach Class VI of the gymnasuim of higher real school, and irregular students may also be accepted, as far as circumstances will permit.

The instruction consists of—(I) theoretical courses ; (II) practical demonstrations ; (III) field exercises in the vineyard or orchard, or in the wine cellars ; (IV) excursions.

Besides the scientific courses including mathematics and the courses in applied science, there are lectures in agriculture, law, and economics, specially orientated, of course.

The aim of the school is to provide sound instruction in viticulture, in the manufacture of wine and its treatment generally, in fruit-culture, the most profitable utilisation of fruit and similar matters. Students are therefore fitted to become proprietors of vineyards and orchards, wine-growers and manufacturers, managers, teachers of lower special schools, directors of schools for viticulture and fruit-culture, or teachers on subjects relating thereto.

The staff of the school consists of the following, viz. :—(I) The Director, responsible to the State Agricultural Department for the teaching, discipline and economical management of the Institution ; (II) three professors ; (III) two lecturers, dealing with agriculture, and with law and economics ; (IV) one supplementary professor ; and (V) several demonstrators for practical experiments and work.

Students in this, as in the other secondary schools, have to render only one year military service.

10. *Academy for the Brewing Industry, Vienna.*—In connection with an Austrian Experimental Station for brewing and malting, the *Akademie für Brauindustrie* (Academy for Brewing Industries) was established in 1895 in a suburb of Vienna. This institution is co-ordinated with the Experimental Station referred to, and with the Technological Industrial Museum, and is directly under the Department of Agriculture.

The object of the Academy is to educate brewing technologists who will, in addition to studies directly appertaining to brewing, possess also that high degree of technical proficiency now requisite in the management of breweries of any magnitude.

The course lasts two years, the first year being devoted mainly to general subjects as the natural sciences, including mathematics, mechanics, etc., and the second year is devoted to the more technical studies, and includes law and economics, industrial hygiene, the care of horses, etc.

The first year work is conducted at the Technological Industrial Museum at Vienna, many of the teaching-staff belonging to that Institution giving instruction, though there are also special professors for the Academy itself. In the second year, the work is carried out in the building of the Academy itself and in the Experimental Station referred to. Here there is a large lecture theatre, a large drawing-room, a well-equipped chemical, biological and microscopical laboratory, a "culture station," and aids for the study of the whole development of breweries, malt-kilns, etc. There is also a completely equipped malt-kiln and brewery for instructional purposes.

After completing the two-year course, a graduation certificate is received, and if three years' practical experience has been had before, or is afterwards attained, the diploma of a brewing master is awarded. Entrance into the Institution may take place either by examination or by qualifying in the Gymnasium or Higher Real School. The character of the course is very thorough.

11. *Farming Schools in Austria.*—What are known as farm schools (*Ackerbauschulen, Wiesenbauschulen*, etc.) are very widely distributed through Bohemia, Moravia, Galicia, and are to be found also in Lower and Upper Austria, and the Tyrol, as well as in other provinces of the Empire.

The farm schools are elementary agricultural schools, the instruction in which lasts the entire year. The duration of the complete course however is from one-and-half to three years, while ordinarily it is two. Their aim is to so educate the lower or peasant class as to enable them to work small farms in a thoroughly intelligent manner ; to develope farms with a view to the production of dairy products, and to teach them the manufacture of these products, the application of recent processes and machinery, etc.

The instruction in the schools embraces :—(I) Work which is a continuation of the work in the elementary school, (II) theoretical instruction in natural science and in its application to agriculture, and (III) practical instruction, not only in ordinary farming operations, but also in other matters with which the farmer should have some acquaintance, such, for example, as carpentry, joinery, etc. ; wheelwright's work, basket-weaving, and similar matters.

The teaching-staff are "regular teachers," specially appointed for farming schools, one being the Director. He is the head of the school, and also of the school farm. There are also assistants. The regular teachers are permanently in the Service of Public Instruction, and have the right of pension, etc.

Many of the schools have sleeping accommodation, etc., hence the number of pupils is limited, frequently to an entrance of twenty for each year's course.

Certificates are issued, one shewing the work done during the course, the other is a certificate of the satisfactory completion of the course.

12. *Agricultural Winter Schools in Austria.*—The number of Agricultural Winter Schools (*Landwirtschaftliche Winterschulen*) in Austria is considerable. There are no less than twenty-six in Bohemia, established between 1883 and 1897, twenty-three in Moravia, established between 1886 and 1898, and they are also to be found in Salzsburg, the Tyrol, Silesia, and Galicia. The pupils are young people who have left the elementary schools and are ordinarily engaged in farming work, etc. The schools are opened during the winter months, however, for instruction, and the pupils return to their occupations in spring.

The schools are of three kinds, viz., (1) Schools with a one-year course; (2) with a two-year course; (3) schools with a one-year course and an optional second year. In the near future probably all the schools will have the complete course, covering two successive winters, type (2). The first and third class of school, especially the former, are recognised as by no means satisfactory.

The advantage of the two winters is that the theoretical foundations can be developed in the first winter, and the technical applications in the second.

The work commences in October and ends in April, and the pupils get their practical experience in actual out-door work not in connection with the school. This is recognised as a limitation, and recently efforts have been made to give short summer courses on kitchen gardening, fruit-culture, and fodder-culture. These are thoroughly practical and supplementary.

The instruction is similar to that in the farming school, but is more brief owing to the limitation of time. The teaching-staff consists of the Director, who teaches the natural sciences and gives technical instruction, and a small number of assistants and supplementary teachers. In Bohemia and Moravia, there are two special teachers in each winter school.

Nearly the whole of these schools are maintained by farming associations, but notwithstanding the regular teachers are State officials with a right to pension.

Certificates are given to those who have satisfactorily passed through the complete course.

13. *Schools for Elementary Forestry.*—In Lower Austria, in Steiermark, Krain, Tirol (Tyrol), Böhmen (Bohemia), Mähren (Moravia), and Galizien (Galicia), two types of schools for elementary forestry have been established, known either as "*Waldbauschulen*" or *Försterschulen*." There is only one school in each of those provinces, but the two types have differences to which attention may be directed.

The *Försterschule* may be described as a school for the training of foresters, and the *Waldbauschule* as a school for instruction in sylviculture.

The forestry school educates people with the intention of making foresters or foresters' assistants, qualifying them for office in the State Forestry Departments, the instruction commencing in the beginning of October and lasting eleven months. In the winter, viz., during the period up to the end of March, the instruction is theoretical and technical; in the summer, excursions for field instructions are made to forests.

The conditions of admission are one year's practical experience in forestry, and the completion of the course in the Folk school or three years in the Higher Real school, etc.

The instruction includes elementary natural science, natural history, mathematical subjects, surveying, planimetry and stereometry, caligraphy and drawing, the technology of sylviculture, the preservation and administration of forests, elementary construction, instruction in hunting, in pisciculture, in the game laws, and in "first aid." The school staff consists of the Director, one or two assistants, foresters, and the more advanced students.

The final examination embraces the general aspects of the subject and is held in the school, and the practical examination which is held in the forest itself.

The "*Waldbauschulen*" or schools for sylviculture are sometimes independent schools or are connected with farming schools or with secondary forestry schools. The course lasts from one to two years. The finest school is at Pisek, about 55 miles from Prague in a southerly direction. This has a two-year course, while the Moravian and Lower Austrian schools have only a one-year course. The conditions of admission are substantially identical with those of the *Försterschulen.* In the Pisek school general agriculture forms a part of the study, which study includes mathematics, natural science, technical subjects, the law concerning game, hunting and fishing. Special attention is being paid to sylviculture and to practical instruction in the forest.

14. *Austrian Dairying Schools, and Country House-keeping Schools.*—Austria has schools—a large number are to be found in Bohemia—in some of which dairying alone is taught, in others, dairying and country house-keeping, and in others again house-keeping alone. The dairying schools are known as *Molkereischulen* or *Meiereischulen*, and the house-keeping schools as *Haushaltungsschulen.* The idea of the dairying school is to give instruction in the management of dairies by modern methods, and girls are admitted to them. The house-keeping schools, which are exclusively for girls, teach them how to manage a country home.

The instruction embraces mode of housing cattle, etc., the management of dairies, kitchen-gardening, fruit-culture in small orchards, the utilisation of fruit, kitchen management including baking and laundry work, feminine hand-work, general hygiene, sick-nursing, arithmetic as applied to keeping household accounts.

The schools are boarding schools, and the importance of practical exercises is accentuated. The course is usually of one year's duration.

15. *Various other forms of Special Schools, Austria.*—Besides the schools previously mentioned, there are what may be called gardening or horticultural schools (*Gartenbauschulen*), schools for fruit-culture (*Obstschulen*, the "*pomologisches Landes-Institut*" may be included); schools for special cultures such as hops (*Hopfenbauschulen*); for vines (*Weinbauschulen*); for flax-growing (*Flachsbauschulen*); Connected with the Agricultural Department there are, moreover, elementary schools for brewing and distilling. These are known as *Brauereischulen*, *Brauerschulen* or *Brau-Fachschulen*, and *Brennereischulen.*

The special schools give theoretical and technical instruction, and practical and experimental field-work. Some of the institutions belong to the State, to Associations, others are communal, and others again purely private.

Students

[1] Incidentally it may be mentioned that Austria has a large number of fine forests and pays serious attention to their welfare and to questions of re-afforestation.

Students of the brewing schools are supposed to have had half a year's experience in the brewery and a folkschool education. In the distilling schools, where the course is seven months, the initial demand is rather more severe, and involves a higher grade of education. In both schools great importance is attached to the practical part of the instruction. By dividing the students into groups and distributing them about among the different parts of the course, the practical work is very quickly and satisfactorily passed through.

16. *Concluding Remarks on Austrian Agricultural Education.*—The preceding account of the provision made for agricultural education in Austria, though inadequate in respect of furnishing information as to details intentionally omitted, gives a fairly comprehensive view of the very rapid progress being made in a form of education that must profoundly affect the creation of national wealth for Austria. The details of courses given in previous chapters will probably be sufficient, and it will be seen on comparing Chapter XLI with the present one that the general policy governing the forms of agricultural education provided is substantially identical in the countries referred to in the two chapters.

17. *Agricultural Education in Denmark.*—Although the Commissioners, through pressure of time, did not study the system of agricultural education of Denmark in detail, they paid a visit to the Royal Veterinary and Agricultural High School[1] (*kongelige Veterinær- og Landbohöjskole*) at Copenhagen, and saw its laboratories and developments, among others the celebrated laboratory for agronomic experiments.[2]

The scheme of grading all dairy products, of furthering the scientific aids of farming and dairying, etc., of creating a totally different outlook on the work of the agriculturist, dairy-farmer, etc., is worthy of mention.

In the earlier history of Danish agricultural education, when the first graduates came from the Agricultural High School, the so-called practical farmers looked upon the scientific courses in agriculture as calculated to develope "faddism." It was believed by them that the higher form of education, instead of turning out practical and successful farmers, would turn out men, who, instead of being able to make farming pay, would probably exhaust their capital on unwise experiments. Experience has shewn that exactly the opposite is the case, and the progress of the *educated* farmer has been so signal, as compared with that of his supposed-practical predecessor, that in Denmark there is no longer any contention as to the economic aspect of agricultural education. The contrast between the farms conducted according to the systems and methods advocated in the high school of agriculture and conducted on the old system is said to have been very striking.

18. *The Veterinary and Agricultural High School of Copenhagen.*—The courses given in this school, which is very finely equipped, are—(1) Veterinary Science, (2) Agriculture, (3) Surveying, (4) Horticulture, (5) Forestry.

The courses in these subjects need not be treated in detail to shew the scope of the work; it will suffice to give the general programme or curriculum.

From what the Commissioners saw of the practical work at the High School, it is evident that the methods and organisation are excellent, and the routine laboratory work, etc., was of the first order.

19. *Curriculum in Veterinary Science, Denmark.*—The work is divided into semesters, half-years; and, as the hours devoted to subjects change, the time-table is given of each semester. This will be also done for each subject.

The course in Veterinary Science, it will be seen, is of a high professional character.

CURRICULUM IN VETERINARY SCIENCE ("UNDERVISNING FOR VETERINÆRER"), COPENHAGEN.

First Course.

Subjects.	Hours per Week.	
	1st Half-year.	2nd Half-year.
Mechanical Physics and Optics	3	2
Chemical Physics	2	...
Inorganic and Analytical Chemistry...	4	...
Organic and Analytical Chemistry	...	4
Botany	3	2
Zoology	4	1
Domestic Animals (until 31st March)...	...	1
The Anatomy and Breeding of Domestic Mammalia	...	3
Laboratory Practice, Demonstrations, etc.		
Chemistry	9	9
Botany	1	1
The Care and Use of the Horse (in April)	...	6

Students work in the laboratories on three days in the week, from 12 to 3. There are botanical excursions, as a rule, on Saturdays.

Second

[1] Some idea of this school can be had from the *Beretning* (Report) and the *Undervisnings- og Eksamensplan* (Programme of Instruction and examination). Kjöbenhavn, 1902.

[2] Some account of the activity of this laboratory will be found in "Le laboratoire d'expériences agronomiques de l'Institut royal vétérinaire et agricole de Copenhague," 1900.

Second Course.

Subjects.	Hours per Week.			
	1st Half-year.	2nd Half-year.	3rd Half-year.	4th Half-year.
Anatomy	5	5	5	5
Physiology	2	2	...	1
Domestic Animals	4	4	...	...
The Theory of Shoeing	1	2	...	...
Pharmacognosis and Pharmacy	3	...	...	...
General Pathology	...	2	2	...
Special Pathology and Therapeutics	...	...	3	3
General Therapeutics and Pharmacodynamics	...	...	1	1
Pathological Anatomy	...	...	2-3	2
Surgery	...	...	3-4	4
Laboratory Practice, Demonstrations, etc.				
Pharmacy	?	?	...	...
Theory of Shoeing	2-4	2-4	...	...
Dissection (from 15th September to 15th April)	?	?	?	?
Normal Histology	?	?	...	...
Form and Structure[1]	1-2	1-2	...	...
Clinics	...	...	14	14

[1] The conformation of animals is studied --their breeds, etc.

Third Course—1st Part.

Subjects.	Hours per Week.	
	1st Half-year.	2nd Half-year.
Special Pathology and Therapeutics	3	3
General Therapeutics and Pharmacodynamics	1	1
Pathological anatomy	2–3	2
" " (experimental work)...	4	4
Surgery	3-4	4
Obstetrics	2	...
Veterinary law	2-3	2–3
Exercises and Experimental Work.		
Clinical Station	14–20	14–20
Dissections	?	?
Pathological Histology	4–6	...
Bacteriology	...	4–6
Surgical operations (from 15th Sept. to 15th April) ...	?	?
Obstetrics	?	...

Third Course—2nd Part.

Laboratory practice, demonstration, etc.
Travelling clinic.
Veterinary law.
Inspection, etc., of meat for consumption ? (Ködbedömmelse og Ködkontrol.).

[2] The letter ö has been used to denote the proper Dano-Norwegian letter.

20. *Curriculum in Agriculture, Denmark.*—The course in Agriculture, though not so severe as that in veterinary medicine, is nevertheless an excellent one. It is as follows :—

CURRICULUM IN AGRICULTURE ("UNDERVISNING FOR LANDBRUGERE"), COPENHAGEN.

First Course.

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
Mechanical Physics and Optics	3	2
Chemical Physics	2	...
Meterology	...	1
Inorganic and Analytical Chemistry	4	...
Organic and Analytical Chemistry...	...	4
Theory of Soils, etc.	...	4
Botany	3	3
Zoology	4	...
Zoology in relation to Agriculture...	1	...
The Structure and Breeding of Domestic Animals ...	...	3
The Theory of Agricultural Tools	2	1
Laboratory Practice, Demonstrations, etc.		
Chemistry	9	9
Botany	1	1
Horticulture (in October and April)	2	2
Surveying (from 1st October to 15th May)	4	2
Drawing	6	6

Second Course.

Subject.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
The Science of Agricultural Implements	2	...
Cultivation of Agricultural Plants...	5	4
Domestic Animals [1](*Husdyrbrug*)	4	4
The Science of Dairying	3 6	4
Agricultural Book-keeping	4	...
The General Science of Agriculture	2 4	5 ...
Vegetable Pathology	2	...
Writing Practice in Agricultural Subject	3	3
Agricultural Chemistry	6	...
Formation and Structure of Animals [1](*Ydrelære*)... ...	2 -3	2–3

[1]Under these headings, viz.—*Husdyrbrug* and *Ydrelære*, several things are studied; for example—Hygiene (*Sundhedslære*), Feeding (*Fodringslære*), Breeding (*Husdyravl*), Breeds (*Racelære*), etc.

21. *Curriculum for Agricultural Engineers and Surveyors, Denmark*—The course in agricultural engineering or surveying is of considerable general interest, for the type of surveyor (*Landinspektör*) so educated would be qualified to professionally assist in agricultural projects.

The curriculum is as follows :—

Curriculum for Agricultural Engineers and Surveyors (" Undervisning for Landinspektörer "), Copenhagen.

First Course.

Subjects.	Hours per Week. 1st Half-year.	2nd Half-year.	3rd Half-year.
Arithmetic and Mathematics	4	5	5
Mechanical Physics and Optics	3	2	...
Chemical Physics	...	...	2
Meteorology	...	1	...
Inorganic and Analytical Chemistry	4	...	...
Organic and Analytical Chemistry	...	...	2
Theory of Soils, etc.	...	4	...
Botany	3	3	...
Surveying (from 1st October)	2	3	...
Laboratory Practice, Demonstrations, etc.			
Physics	...	...	2
Chemistry	...	9	9
Botany	1	1	...
Drawing	8	8	8–12
Surveying	...	2	...

The botanical excursions take place on Saturdays generally.

Second Course.

Subjects.	Hours per Week. 1st Half-year.	2nd Half-year.	3rd Half-year.
Land Surveying	5	6	4
Cadastral Surveying, etc.	4	3	2
Farming	2	2	1
The Cultivation of Agricultural Plants	...	5	4
General Theory of Agriculture	...	{ 2 { 4	5
Engineering	3	4	...
General Economics	3–4	...	...
Practical Exercises.			
Surveying (from 1st October)	...	2–4	2–4
Engineering	...	8	8
Drawing	8	8	8

22. *Curriculum in Horticulture, Denmark.*—Horticulture is treated thoroughly, and on a wide basis as will be seen from the following curriculum :—

CURRICULUM IN HORTICULTURE ("UNDERVISNING FOR HAVEBRUGERE"), COPENHAGEN.

First Course.

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
Mechanical Physics and Optics	3	2
Chemical Physics	2	...
Meteorology	...	1
Inorganic and Analytical Chemistry	4	...
Organic and Analytical Chemistry	...	4
Theory of Soils, etc.	...	4
Botany	3	3
Elementary Horticulture	1	...
Laboratory Practice, Demonstrations, etc.		
Chemistry	9	9
Botany	1	1
Horticulture	...	1
Surveying (from 1st October to 15th May)	4	2
Drawing	6	6

Second Course.

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
Horticultural Economics and the General Theory of Horticulture	3	...
The Cultivation of the Vegetable Garden	...	3
Fruit-culture and Management of the Nursery	3	1
The Cultivation of Flowers	...	3
Plant Forcing	...	2
Horticultural Botany	2	2
Vegetable Pathology	2	2
Agriculture in Relation to Zoology	1	...
Laboratory Practice, Demonstrations, etc.		
Agricultural Chemistry	...	6
Horticultural Botany	2	2
The Construction of Horticultural Charts	6	6
Horticulture	1-4	1-4

23.

23. *Curriculum in Forestry, Denmark.* The course in Forestry is developed as hereunder:—

CURRICULUM FORESTRY ("UNDERVISNING FOR SKOVBRUGERE"), COPENHAGEN.

First Course.

Subjects.	Hours per week.		
	1st Half-year.	2nd Half-year.	3rd Half-year.
Arithmetics and Mathematics[1]	4	5	4
Mechanical Physics and Optics	3	2	...
Chemical Physics	2	...	...
Meteorology	...	1	...
Inorganic and Analytical Chemistry	4	...	...
Organic and Analytical Chemistry	...	4	...
Theory of Soils, etc.	...	4	2
Botany	3	...	...
The Botany of Forests	...	3	3
Introduction to the Study of Forestry (until 31st October)	2	...	...
Laboratory Practice, Demonstrations, etc.			
Physics	...	...	2
Chemistry	...	9	9
Botany	1	...	...
Forest Botany	...	1	1
Drawing	6	6	6

Second Course.

Subjects.	Hours per week.			
	1st Half-year.	2nd Half-year.	3rd Half-year.	4th Half-year.
Economics	3	4	2	...
Knowledge of Merchandise and Commerce	3	3	2	...
Measurement and Extension of Forests	4	2	...	...
Forestry Economics	...	...	2	3
Theory of Administration	...	3	2	...
History and Statistics	...	...	...	...
Land Surveying and Levelling	3	1–2	...	4
Vegetable Pathology	2	2	...	...
Forest Zoology	3	...	...	...
General Economy	3 4	...	...	...
Farming	...	...	2	1
Forestry	2	2	2	2
Practical Forestry	...	...	3	3
Surveying	2	...	...	...

24. *General Remarks on Danish Agricultural Education.*—By the thorough organisation of all dairy-farms in Denmark, the establishment first of a central testing station in Copenhagen, and later stations in different parts of Denmark, for the examination of dairy-products, the efficiency of dairy-farming has been enormously increased.

The Commissioners paid a visit to the Laboratory for Agronomical experiments, from which have issued so many researches of value, viz., by Professor V. Storch, N. I. Fjord, and others.

At the Central Institute at Copenhagen, butter is so graded and dealt with that the product is uniformly satisfactory, and this has had a very good effect on the preference for Danish butter in foreign markets. Where any defect is observed, the farmers are advised as to its correction, and in this way the effort to produce butter of the highest quality is continuously maintained.

A map shewing all the dairy-stations in Denmark may be seen at the Central Stations, and one can see at a glance the scheme of control for each dairy-farm. Any country proposing to secure good markets for its dairy-products would do well to adopt the Danish control system, and its reputation for dairy-products would be at least uniform.

25. *Agricultural Education in Italy.*—Italy recently has been strongly impressed with the national importance of improved and more widely extended Agricultural Education. Dr. Guido Baccelli, Minister of Education, so pointedly urged this importance that land-owners have gratuitously given little plots (*campicelli*) for practical instruction in Agriculture. The number of these is now probably over 6,000, and their value not less than £50,000.[2]

The instruction in the elementary rural schools has been orientated agriculturally. Over 250,000 pupils receive practical lessons in Agriculture, and the effect of this will be to considerably lighten the load of the peasants (*contadini*). Not

[1] Includes the elements of the differential and integral calculus.
[2] The fine public spirit displayed by the Italian landed proprietors is worthy of special remark.

Not only did landed proprietors respond to the public appeal of the Minister, but school authorities, teachers, farmers, etc., royally helped. Teachers attended in thousands to hear lectures, and a very large number, about 2,000 in one year, of lectures were given by University professors, professors in the technical "institutes," the directors of practical or special schools of agriculture, prominent agriculturists, agricultural engineers, etc., etc.

This elementary instruction touched upon the modern knowledge of the part played by bacteria, leguminous crops, rotation, the economic importance of manuring, of fertilisers, of tilth and of farm implements and machinery, the significance of seed-selection, the necessity of a study of climatological and meteorological conditions, the nature of plant diseases and the treatment and eradication of the same.

In order that teachers should be able to deal with such matters in the primary schools, not only were the special lectures referred to given, special instruction was afforded in the normal school. This covered a very wide range, and among other matters, touched on the following, viz.:—The difference between arable and uncultivated lands; the nature of subsoils; the consequences of drainage and of irrigation; the significance of tilth, of the use of machinery for that purpose; the conservation and use of stable manures, and the use of chemical fertilisers; the cultivation of cereals, of textile dyeing, oil-bearing and aromatic plants; meadow-cultivation; orchards; the diseases of trees; insect pests; the drying and conservation of fruits; viticulture, including site and soil selection; various kinds of vine and their propagation; vine diseases, etc.; wine-making, vitiation of wine, and its remedying; cultivation of the mulberry and propagation of the silkworm; olive cultivation and the extraction of oil; apiaries; the dairy and poultry yard; the rearing of cattle and pigs, etc.; hygiene; elementary toxicology; and also such a subject as book-keeping.

The value of this instruction in Italy is believed to be very great.

26. *Practical Schools of Agriculture, Italy.*—By the law of 6th June, 1885, practical schools of agriculture (*scuole pratiche di agricoltura*) may be established in Italy, one at least in each province,[1] and also special schools (*scuole speciali*). The latter are in the minority, and are about one fourth of the whole.

Special schools include those for viticulture, wine-making; olive cultivation and the extraction of the oil; orchard culture; horticulture; dairying and cheese-making, cattle-rearing, etc., etc. The instruction in these is of course very much better than in the elementary school.

Experimental Agronomical Institutes, etc., Italy.—Among the higher grades of agricultural investigation and instruction, may be mentioned the Experimental Agrarion Institute of Perugia (*Istituto agrario sperimentale fondato in Perugia*).[2] The function of these institutes is educational, they are not merely experimental stations.

There are also Agronomical Stations and schools of agriculture, for example, of Milan and Portici. (*Stazioni agrarie e scuole di agricoltura di Milano e Portici.*)

27. *Higher Schools of Agriculture, Italy.*—There are a number of higher schools of agriculture in Italy, for example, the Agronomical School of the Royal University of Pisa (*Scuola agraria della Regia Università di Pisa*), the higher school of agriculture of Portici (*Scuola superiore di agricultura di Portici*), the Royal Higher School of Agriculture of Milan (*Regia scuola superiore di agricoltura di Milano.*)

It will be a sufficient illustration of the type of instruction to refer to the features of, say, the Milan, and Pisa Schools. In the former the subjects may be grouped under two heads:—

(1). General (*materie d'indole generale*).
(2). Special (*materie speciali*).

The first includes general chemistry, inorganic and organic, systematic botany, vegetable morphology and physiology, zoology, mineralogy, and geology, drawing, supplementary physics and mechanics, meteorology.

The second includes practical geometry, agricultural chemistry, chemico-agricultural technology, agricultural botany, vegetable pathology, agricultural zoology, zootechnics with conceptions regarding the hygiene of animals, agricultural accountancy, agriculture, rural economics and estimates, special cultivations (as for example, viticulture, horticulture, fruit culture, forestry, etc.), apiculture, agricultural mechanics, agricultural hydraulics and drainage, rural legislation.

The fees for this school are:—Annual inscription (regular course) 100 lire (£4); "auditors,"[3] for each course, inscription, 20 lire (16s.); diploma, examination fee (*laurea*), 100 lire (£4); examination tax 20 lire (16s.).

The curriculum in the Portici School is the same as the preceding.

28. *University School of Agriculture at Pisa.*—Agriculture is taught in the University of Pisa, and the school of agriculture there is known as the *Scuola agraria universitaria di Pisa.* It is an integral part of the Faculty of mathematical, physical and natural science.[4]

The instruction falls under four heads:—

I. Agriculture proper (*Discipline agrarie propriamente dette*).
II. Agricultural technology (*Tecnologia agraria*).
III. Natural science, pure, and applied to agriculture (*Scienze naturali in generale e nelle loro speciali applicazioni all' agronomia*).
IV. Economic and juridical science as applying to agriculture (*Scienze economiche e giuridiche attinenti all' agronomia.*)

Under

---

[1] Legge 6 giugno 1885, n. 3141. relativa alla istituzione delle Scuole speciali e pratiche di agricoltura. Codice pubblica istruzione, vol. 4 to. See pp. 244-292.

[2] *Ibid*, p. 280.

[3] Irregular students.

[4] Vide:—Regolamento della Scuola agraria universitaria di Pisa, art. 1-22. Reg. decr. 26 ottobre 1875, n. 2747. Cod. Pub. Istruz. Vol. IV, pp. 281-287. Also R. decr. 18 agosto 1896 n. 439, 22 maggio 1898, n. 200, 27 novembre 1898, n. 515, op. cit pp. 288-290.

Under these four heads the following detailed subjects are arranged, viz.:—

I. (1) Agronomy; (2) Agriculture; (3) Rural economy; (4) Zootechnics; (5) Rural valuations, etc.

II. (1) Accountancy; (2) Elements of descriptive geometry with drawing; (3) Mechanics as applied to agriculture; (4) Architecture and rural hydraulics; (5) Topography and practical geometry (surveying) with exercises (field work) and drawing.

III. (1) Physics; (2) Inorganic and organic chemistry; (3) General and agricultural botany; (4) Mineralogy; (5) General and agricultural geology; (6) Physical geography and meteorology; (7) Agricultural chemistry; (8) The anatomy, physiology, and external conformation of domestic animals; (9) General and agricultural zoology.

IV. (1) Political economy; (2) Agricultural legislation and statistics.

This programme expresses with sufficient distinctness the Italian conception of what is involved in a course of scientific agriculture.

29. *Agricultural Education in Norway.*—The increasing importance of agricultural education is being recognised in Norway, and a portion of the Agricultural vote (between £40,000 and £50,000) is devoted to agricultural, dairy, and horticultural schools, laboritories, etc, There is an Agricultural College at Kristiania (with an associated farm at Aas), established since 1859. Up to 1897 the course was for agriculture only, but now includes horticulture, dairy-farming, surveying and forestry. Its staff is about nine professors, ten teachers, and a number of instructors.

The stay of the Commissioners in Norway was so limited that no time could be devoted to the detailed study of its system of agricultural education.

30. *Agricultural Education in Sweden.*—Systematic instruction in agriculture in Sweden can be referred as far back as the so-called "Era of Liberty," 1718-72. During this period, chairs for the advancement of agricultural knowledge were established at Lund and Upsala. A little later, viz., in 1811, an Academy of Agriculture (*Landtbruksakademien*) was founded. A general awakening as to the need of agricultural schools following the model of the celebrated Thaer's School at Moglin, in Germany, previously referred to in this report, led, after some time, to the establishment of three types of school, viz.:—

(1) Agricultural Schools (*Landtbrukskolorna*) in which both primary and secondary education are given in agriculture, this being partly theoretical and partly practical.

(2) Farmers' Schools (*Landtmannaskolorna*) in which the agricultural education is of a primary and practical character, and—

(3) Agricultural High Schools or Institutes (*Landtbruksinstituten*) for higher and professional agricultural education.

It may be mentioned, as shewing the far-reaching influence of Thaer's work in Germany, that a private agricultural school was founded in Sweden in 1833 by Edward Nonnen (1804-62), a pupil of the Möglin School. This was established at Degeberg, near Lake Venern, and lasted till 1852, up to which time it had received 200 pupils. It was subsidised by the State.

These several types of school are under the control of the Royal Department of Agriculture (*Landtbrukstyrelsen.*)

There are also State dairy schools, schools for farriery, for forestry, etc.

The several classes of schools will be referred to hereinafter, without any attention to mere detail.

31. *Agricultural Schools, Sweden.*—The "*Landtsbruksskolorna*" of Sweden, the first of which was opened in 1840 on the Orup's Estate in Skåne, as the result of Government grants, afford training and develope skill in the carrying out of the various kinds of farm labour, and give some degree of instruction in theoretical principles. The pupils have to undertake every kind of farm labour and to act also as foremen. The prominent feature of the school is to afford that training for pupils which will enable them to become *directors* of labour.

There are at present twenty-six such agricultural schools, two being connected with the two agricultural high-schools, of the others there is, in general, one in each shire (Län). The annual number of pupils is about 350. The course of instruction extends over two years, but for advanced pupils this is reduced to one year. The theoretical instruction is given in the morning, and during the winter in the evening.

The entrance conditions are: -The candidate shall be 18 years of age; he must be accustomed to farm work, and have passed through the minimum course of the elementary school. Instruction, board, and lodging are provided free of cost.

32. *Farming or Agronomical Schools, Sweden.*—The "*Landtmannaskolorna*" of Sweden are really adjuncts of higher primary schools (*Folkhögskolorna*) and are practically a sort of higher or continuation course, orientated with reference to agriculture. The schools are subsidised by the State, but the pupils pay a fee for the instruction and provide their own board. The State contribution is limited to £167 per annum (3,000 kronor) for each school, the school's income having to be of an equal amount. There are about twenty such schools, with about 260 pupils.

There are farm schools "winter schools," the instruction lasting from five to six months. The pupils must be from 18 to 20 years of age, and must have passed through an education equal to that given in a primary school. Further than this, the pupil must have been engaged for one year in some agricultural calling.

33.

33. *Agricultural Institutes, Sweden.*—There are two agricultural institutes (*Landtbruksinstituten*) in Sweden, one at Ultuna close to Upsala to the north of Stockholm, the other at Alnarp. The course is one of two years, and includes the following subjects :—

(i) *Fundamental Sciences :*—Applied mathematics, mechanics, physics, meteorology, chemistry, geology, botany, zoology, anatomy and physiology of domestic animals, geodesy and surveying, levelling, drawing.

(ii) *Principal Technical Subjects :*—Agronomy, zootechnics, dairying, farm machinery, implements, rural construction, rural economics, aud book-keeping.

(iii) *Secondary Technical Subjects :*—Special therapeutics relating to the domestic animals, sylviculture horticulture, political economy, economic law, communal law.

The conditions of entrance are that the student must be 18 years of age; that he must have spent one year in practical agriculture; that he must also have passed the leading examination of the elementary technical schools, or the sixth class of the modern section of a State Lyceum (*Läroverk*).

The teaching staff consists of professors (*Lektorer*), assistant professors (*Adjunkter*), and assistant masters. One of the first is appointed by the king for five years as warden or rector.

A farm manager under the supervision of the director is required to explain to the pupils the entire organisation of the agricultural property, the scheme of its management, and of the cultivation thereon.

Pupils at the Higher Colleges do not actually undertake farm work.—The fees are 100 kronor (say £5 11s.) per annum, but the students pay for their board in addition to this.

The number of pupils at the two agricultural institutes is between sixty and seventy, from which it is obvious that the cost to the State of their education is considerable.

It may be mentioned that there are a limited number of scholarships available for students.

34. *Swedish Dairying Schools.*—The part that Sweden has played in the improvement of the modern dairy is well known [1].

The State and some associations for the promotion of rural economy have establisbed a number of dairying schools. At Alnarp there is a Dairying Institute with a higher and an ordinary dairying school.

The higher school requires previous experience of one year in a dairy, two years at a higher agricultural school. It qualifies for teaching in dairy-management.

The lower school also demands one year's experience, certificate of passing through an ordinary school, and the age must be nineteen.

The fees are 600 kronor (£33 6s.) for the high school, and 400 kronor (£22 4s.) for the lower school for the year. Only twelve pupils are received each year.

The Dairying School of Åtvidaberg gives two six-month courses to adults (men and women) who already have practical experience. Fee, 180 kronor (£10). Only four pupils are received.

The school at Björkfors has a one year course.

There are *State dairying stations* with two-year courses, in which pupils receive board, lodging, free instruction and 50 kronor (£2 15s.) per annum. There are eighteen for the first year's work and eight for the second year's, the former being entirely practical, the latter partly theoretical also. The entire cost to the State is about £1,500 per annum.

Societies for rural economy or agricultural societies, support forms of teaching similar to that last mentioned, at a cost of about £833 per annum.

35. *Swedish Farriery Schools.*—There are schools for farriery at Stockholm, Alnarp, and Skara The Alnarp School, opened in 1863, through the initiative of Dr. O. Pehrsson-Bendz, has the highest reputation. It has a fine building completed in 1877.

The instruction is given by the staff of the Alnarp Agricultural High School.

There is a *Veterinary Institute* also in Stockholm, to which detailed reference need not be made. The course is four to five years. There are 340 veterinary surgeons in the kingdom.

36. *Instruction in Forestry, The Institute of Forestry, Sweden.*—The Stockholm Institute of Forestry (*Skogsinstitutet*) has two courses in forestry, a higher and a lower. The conditions of admission to the lower course are that candidates shall have qualified for the sixth class of a State Lyceum (Läroverk)[2] and shall have since then been employed for at least two years in practical work in forestry, or anything directly appertaining thereto. To be admitted to the higher course it is necessary to have passed the university entrance examination on the scientific side, or should the classical side have been taken, to pass a supplementary examination in mathematics, physics, and chemistry, the grade of which shall be equal to the qualification for university entrance.

It is further necessary (now) that the candidates shall have passed through a one-years' preparatory course at the Omberg School of Forestry.

The higher course is available for thirty students only. The

---

[1] At Gedsholm in Skåne in 1840, R. Tornérhjelm developed what is known as the Holstein system of separating the cream. The P. U. Gussander (1793-1871) system was also tried. Then in 1864, J. G. Swartz's (1819-1865) ice-method was invented and became popular in Austria, Denmark, Finland, Germany, Norway, etc. This was supplanted by the separating system 1878. Dr. Gustaf de Laval's *Separators*, C. A. Johansson's *Extractor* 1887, A. Wahlin's *Accumulator*, and E. G. N. Salenius' *Radiator* are probably too well known to need more than mention.

[2] That is four years before qualification to enter a university.

The course is theoretical and practical, the latter, embracing about four months in summer in each of the two years of the course. The curriculum embraces the following subjects:—

(i). *Special Technical Subjects.*—Forestry economics, including management of forests, forestry, technology, afforestation, geodesy and surveying, distribution of forests, mathematics as applied to forestry, agronomy, forestry and game administration.

(ii) *Fundamental Sciences.*—Botany, diseases of trees, game, its preservation, etc., geology and geognosy, zoology, mineralogy, chemistry, physics, meteorology, climatology, economics, and financial science.

(iii) *General Subjects.*—Law, political economy, accountancy, as applied to forestry, etc.

The staff consists of a director, two professors (*lektorer*), four masters, and assistants for practical work.

37. *Lower Forestry Schools, Sweden.*—There are now eight forestry schools in Sweden, two are preparatory schools for the "*Institutet,*" six are for the education of forest-rangers.
The course of instruction embraces the following subjects, viz:—

(i) *Theoretical and Technical.*—Forestry economics, botany, zoology, mathematics, cartography, writing, accountancy, gamekeeping and preservation, management of forests, the regulations as to supervision of forests.

(ii) *Practical Work.*—Forest and field surveying, sylviculture, the thinning and exploitation of forests.

The course is uniformly one year. Ten pupils annually are lodged gratuitously.

38. *Concluding Remarks.*—Sweden clearly recognises the increasing importance of the various forms of agricultural education. It has established chemical-analysis stations at Skara, Halmstad, Kalmar, Vesteräs, Orebro, Jönköping, Hernösand, Luleå, and Visby, nine in all. Each receives a State subsidy of £222 (4,000 kronor, Luleå, 5,000 kronor), and from the agricultural societies from £111 to £295 (2,000 to 5,300 kronor). They have an income also from analysis, amounting in one case to about 6,000 kronor (£333).
With the exception of the Jönköping station, all these are connected with *seed-control stations.* In 1901, 11,273 analyses were made, and about 8,000,000lb. of seed were examined.
A considerable number of experimental farms exist, which are educational in their function. The experiments are accurately conducted, and are carried out on a strictly scientific basis.
In conclusion, it may be remarked that the methods of Sweden in regard both to agriculture and forestry offer definite suggestions as regards the management of the Public estate in New South Wales, and the assistance of that primary production on which much else depends.

CHAPTER XLIII.

CHAPTER XLIII.

Agricultural Education in Switzerland.

[G. H. KNIBBS.]

1. *Introduction.*—Although the whole provision for agricultural education in Switzerland was not examined by the Commissioners, on account of the great limitation of time for their task, certain features were observed as opportunity allowed. At Zürich, for example, a visit was paid to the Federal Polytechnicum *(die eidgenössische polytechnische Schule)*, which has an agricultural and forestry department *(Land und forstwirtschaftliche Abteilung*. This department has three branches, viz. (i) A School of Forestry (*Forstschule*); (ii) A School of Agriculture (*Landwirtschaftliche Schule*); and (iii) An Agricultural Engineering School (*Kultur-Ingenieur-Schule*).

At Lausanne, the "Institut Agricole," in which practical agriculture is taught, was also visited. Besides these, the school for veterinary medicine (*Tierarzneischule*) in Zürich, and the one in Berne, were also seen. Then there are dairying schools, such as that at Moudon[1]. A brief reference to some of these will probably be sufficient.

2. *The Agricultural and Forestry Department of the Polytechnic at Zürich.*—The Zürich Polytechnicum was founded in 1854. It has annexed to its various schools, experimental stations. These are known as *Annex-Anstalten*; for example, there is a federal central station for forestry experiments in connection with the forestry school (*die eidgenössische Zentralstation für das forstliche Versuchswesen*), founded in 1885. There is also an experimental station for agriculture (*die eidgenössischen Anstalten für landwirtschaftliche Untersuchungen*) connected with the agricultural school, this last embracing two divisions, viz.: (1) the station for agricultural chemical experiments (*die agrikulturchemische Untersuchungsstation*) and (2) the seed-testing station (*die Samenkontrollstation*).

As is well known, the equipment of the Federal Polytechnicum at Zürich is of a very complete description; it is one of the greatest schools of the world, and its teaching is of the highest order. It will perhaps be sufficient to give the programmes of the schools dealing with forestry, agriculture, and agricultural engineering. These will be taken in the order indicated in the programme for the year 1902–3.

3. *School of Forestry, Zürich.*—The course in forestry lasts six semesters, that is to say, three years. The details of the work are as shewn in the following tables, viz.:—

(A.) SCHOOL OF FORESTRY (6 SEMESTERS).

I Year—1st and 2nd Semesters.

Subjects.	Hours per Week.
Higher Mathematics	5
Exercises in Mathematics	2
Inorganic Chemistry, with "Repetition"	4
Introduction to the Forestry Sciences	1
Excursions	½ day
General Botany	3
"Repetition"	1
General Zoology, with special regard to animals of most importance in agriculture and forestry	4
"Repetition"	1
Plan-drawing	4
Technical Arithmetic	1
The elements of National Economy	3
"Repetition"	1
Political Economy	2
"Repetition"	1

II Year—3rd and 4th Semesters.

Subjects.	Hours per Week.
Physics	4
"Repetition"	1
Forest Culture, Part I.	5
Excursion and Exercises	1 day.
The Theory of the Nutrition of Plants	2
Surveying	3
Exercises	2
General Geology	4
"Repetition"	1
The Pathology of Plants with "Repetition"	1
Practical Microscopy	2
Meteorology and Climatology	3
Science of Finance	2
"Repetition"	1
Financial Science (French)	2
"Repetition"	1

III

[1] Also seen by the Commissioners.

III Year—5th and 6th Semesters.

Subjects.	Hours per Week.
Protection of Forests	3
Political Forestry, Police Forestry, and Statistics	4
The arrangements of Forests	4
The utilisation of Forests	3
Excursions and Exercises	1 day
Forest Culture, Part II (selected chapter)	2

III Year—continued.

Subjects.	Hours per Week.
Road and Water-works, with "Repetition"...	4
Exercises in Design	4
Traffic Laws (Part II), with "Repetition"	3
Fishing and Pisciculture	2
Mountain Pasturage	1
Pathology of Plants, with "Repetition"	1

4. *School of Agriculture, Zürich.*—The School of Agriculture lasts five semesters, that is to say, two and a half years. For those who desire to give special attention to dairying there is a modification in the second and third year work, indicated hereunder.

The programme of instruction and work is as follows, viz.: —

(B.)—*School of Agriculture*—(5 Semesters).

I Year—1st and 2nd Semesters.

Subjects.	Hours per Week.
Mathematics	4
Inorganic Chemistry, with "Repetition"	4
General Botany	3
"Repetition"	1
General Zoology, with regard to animals of most importance in agriculture and forestry	4
"Repetition"	1
The elements of National Economy ...	3
"Repetition"	1
Political Economy	2
"Repetition"	1
The theory of Practical Agriculture, I Part	2

II Year—3rd and 4th Semesters.

Subjects.	Hours per Week.
Physics...	4
"Repetition"	1
Theory and Practice of General Agriculture, II Part	3
"Repetition"	1
The general theory of the Breeding of Animals	2
"Repetition"	1
Climatology and the Science of Agriculture	3
Cultivation and Manuring	3
Bacteriology for Farmers, I Part ...	1
Agricultural Chemistry, I Part. The theory of plant nutrition	2
The regimen of Domestic Animals ...	2
Plant pathology, with "Repetition"...	1
Practical Microscopy	2
Fruit Culture and the Science of Fruit-growing	1
General Geology	4
"Repetition"	1
Agricultural Machines and Tools, I Part	2
Agricultural constructions	2
Financial Science (German)	2
"Repetition"	1
Financial Science (in French) ...	2
"Repetition"	1

III Year—5th Semester.

Subjects.	Hours per Week.
Estimation of Agricultural Production	1
Agricultural Book-keeping	2
The Breeding of Sheep, Pigs, etc. ...	2
Agronomical Exercises, including the Examination of Milk	3
Cattle-breeding, II Part	2
Draining and Irrigation	2
Agronomical Exercises	2
Agricultural-chemical Technology (the Manufacture of Sugar and Spirits, Chemistry of Dairying, etc.) ...	2
Dairy technique	2
Practice in the Agricultural-chemistry Laboratory	8
Bacteriological Laboratory Practice ...	4
Viticulture and the Manufacture of Wine	1
Commercial Laws (II Part), with "Repetition"	3
Elements of the Equipment for Agricultural Industry	2
Agricultural Arithmetic, with Exercises	1
Agricultural Seminarial Exercises ...	2
Forestry for Farmers	2
The Pathology of Plants, with "Repetition"	1

II Year—1st and 2nd Semesters.

For Students who intend to specially study dairying:—

Dairy Technique—II Year.

	Hours per Week.
Mountain Flora	1
Mountain Pasturage	1
Chemistry of Milk and Milk Products	2
Dairy Technique I	2

III Year—5th Semester.

Dairy Book-keeping	
Laboratory Practice in Bacteriology...	12

5. *School of Agricultural Engineering.*—The course in agricultural engineering is a 5-semester course, that is to say, it occupies two and a half years. The profession of the agricultural engineer (Kultur-Ingenieur) is a well-recognised one in Europe, and is one which is of great assistance in the development of primary production. The high character of the course will be apparent on a study of the range of subjects undertaken.

The

The curriculum is as follows :—

(C.) Agricultural Engineering School (5 Semesters).

I Year—1st and 2nd Semesters.

Subjects.	Hours per Week.
Differential Calculus	4
"Repetition" and Exercises	3
Differential Calculus (in French) ...	4
"Repetition" and Exercises	3
Descriptive Geometry...	4
"Repetition" and Exercises	5
Descriptive Geometry (in French) ...	4
"Repetition" and Exercises	5
Analytical Geometry	4
"Repetition"	1
Drawing of Plans	4
Technical Arithmetic	1
Agricultural Botany with "Repetition"	3

II Year—3rd and 4th Semesters.

Subjects.	Hours per Week.
Physics...	4
"Repetition	1
Surveying	5
"Repetition"	1
Exercises in Surveying	2
Cadastral Surveying	3
Exercises	2
Road and Water-works with "Repetition"	4
Exercises in Design	4
Agricultural Science	3
General Geology	4
"Repetition"	1
Climatology and Science of Agriculture	3
Mountain Agriculture	1

III Year—5th Semester.

Subjects.	Hours per Week.
Projection of Maps	1
Agricultural Technics	3
Exercises in Design	6
Geodetical Practice	2
Commercial Law (II Part), with "Repetition"	3
Law relating to Technics (viz., to buildings, railways, and water-rights)	2

6. *Seed-testing Station, etc., Zürich.*—The Commissioners visited the seed-testing station in connection with the agricultural course. The examination embraces, among other things, the size, perfection, germination-frequency, etc., of the seeds.

The station for the analysis of soils, fertilisers, etc., is near the seed-testing station, and is excellently equipped.

The central administration for all agricultural experimental stations is at Liebefeld, Berne.[1] Considerable progress is being made in agricultural development through scientific instruction.

7. *Agricultural education at Lausanne, Switzerland.*—Among other places, some little time was spent by the Commissioners at Lausanne in the study of the Swiss developments in Agricultural Education. The Winter Course of the Cantonal School of Agriculture is given at the "*Institut Agricole, du Champ-de-l'Air,*" at that Capital. It commences about the beginning of November, and lasts till about the middle of March. The instruction is attended by natives of the Canton of Vaud, by about half as many from the other Swiss Cantons, and by a small number of foreigners. The complete programme covers two years, and is developed as follows :—

Course in the "Institut Agricole," Lausanne.

First Year.

Agrology (3 hours)[2].—This includes :—(a) The physical properties of the soil, and its functions in regard to moisture; the absorption of air; and the absorption and retention of heat: (b) Mechanical means of changing the properties of the soil; drainage and its cost; irrigation; various forms of labour expended on agricultural plots.

Swiss Agriculture (2 hours).—The importance and future of the agricultural industry; the general character of Swiss agriculture; climate and its influence; the various regions, viz., valley and hills, the mountainous and Alpine region; soil-formation and comparison between the condition of things in Switzerland, Belgium, Holland, and Sweden. Swiss agricultural plants; cattle; intensive and extensive culture; importation and exportation.

Agricultural Botany (3 hours).—The rôle of plants. Botanical divisions; description of plant-organs; plant-reproduction; questions of fecundation and hybridisation, and constitution; physiology; the outlines of geographical botany; and descriptive botany.

General and Agricultural Chemistry (3 hours).—General ideas, physical conceptions, the nomenclature and notation of chemistry.

Descriptive Chemistry (2 hours).—Metalloids. The function of nitrates, and of nitrogen, nitrogen fertilizers, carbon, hydro-carbons, etc., and their rôle in plant-life. Sulphur, phosphorus, etc., and the part they also play in plant-life. Phosphate fertilizers. Silica and its function in plant-life; metals, organic chemistry, proteids, ferments.

Agricultural book-keeping (1 hour).—Discussions of the profits and losses of the agriculturist, and the circumstances which affect these. Book-keeping in single and double entry; registries, inventories, budgets, etc. The complete accounts of a farm of 15 hectares are kept, by way of demonstration and practice.

Linear Drawing (2 hours).—Drawing of geometrical figures; of agricultural machines; and of agricultural buildings.

Geology

[1] Centralverwaltung der schweiz. landwirts. Versuchs und Untersuchungsanstalten.
[2] The number of hours per week throughout.

Geology (2 hours).—As the way in which this subject is taken was not mentioned in connection with the other courses in Agriculture, the programme is given somewhat more fully. The aim and application of Geology appropriate to Agriculture are elucidated as follows :—Daily modification of our earth ; the modifying agents ; the atmosphere and aerial erosion ; effect of frost ; movement of sand and sand-dunes ; steppes and deserts ; geological conditions giving rise to springs of infiltrated water ; deep and superficial springs and their régime ; land-slips and other movements of the surface ; their causes, precursory phænomena, consequences and prevention ; running-water ; torrents ; their effects, their utility and disadvantages ; erosion, sedimentation caused by torrents ; principles of improving their course ; streams and rivers ; work of great rivers ; deltas, alluvial deposit ; sheets of water ; lakes, rivers, and oceans ; glaciers and their phænomena ; their influence upon the climate of valleys ; ancient glaciers and their influence upon the nature of the soil of Switzerland. The influence of organised beings upon our globe ; internal forces ; minerals, their forms and properties ; principal kinds and the part they play in the formation of earth ; products of their decomposition ; generalities as to the terrestrial crust and its formation ; a table of geological epochs. Ground-plots in general.

Switzerland and its Cantons, maps and geological profiles ; geological agriculture ; generalities. Relation of the chemical knowledge of the soil to geology ; complementary and fertilizing material ; agronomic geological charts ; agricultural surveys and appraisements ; study of the ground ; of the various geological epochs ; and their relation to the soil, and to cultivation. Switzerland and the Canton of Vaud.

Geometry and Measurement (1½ hour).—(*a*) Weights and measures ; origin of the Metric system ; countries which have adopted it ; measures of length, of surface, of volume and capacity ; weight. Federal law, its dispositions ; the monetary system ; (*b*) Measurement of surfaces ; calculation of the square, rectangle, parallelogram, rhombic figures ; triangles, trapeziums, and polygons ; regular or irregular figures. The circumference, sector, or segment of a circle ; setting out an ellipse for gardeners. (*c*) Cubature of solids, area of surface, volume, various forms of prism, pyramids, cylinder, cones, sphere and spherical sector ; gauging of casks, of heaps of gravel, etc.

Civic Instruction (1 hour).—Public Cantonal Law ; general principles of public law ; international relations ; study and history of the Cantonal Constitution ; examination of the principal laws of the Canton Vaud ; exercise of political rights ; communal organisation, etc.

Rural Legislation (1 hour).—Federal and Cantonal Law ; their purpose ; distinctions as regards property, movables and immovables ; the public domain ; property ; usufruct ; service ; the rural code ; limits ; boundary adjustment ; intermediary closures ; walls ; plantations ; the law respecting roads ; passages ; mode of acquiring service ; title ; prescription, etc. ; the head of a family ; law concerning real property.

Agricultural Mechanics (2 hours).—The subjects treated are : Force and motion ; forms of motion ; of force ; centre of gravity ; machines in a state of equilibrium ; of uniform movement ; the production and modification of movement by force ; passive resistance, or inertia ; machines, with the condition of non-uniform movement ; transport of loads ; motors ; hydraulics.

Each of these subjects is treated with some degree of fulness. The details for the last-mentioned subject will perhaps give a sufficient indication. In hydraulics then the following details are treated :—

The motion of water at an orifice ; ajutages and their effects ; the syphon ; constant and variable flow ; motion in pipes ; in canals and rivers ; measurement of velocity ; gauging.

Agricultural meteorology (2 hours).—It is desirable to give a fairly full indication of the way in which this subject is treated, which is as follows :—

General aperçu of meteorology. General study of the atmosphere ; its constituent gases from the point of view of agriculture ; floating organic germs.

Heat.—Thermometers, their use ; method of observing ; mean temperature ; temperature curves ; sources of heat ; interior heat ; isogeothermal lines. Solar heat ; the movement of solar heat in the earth's crust ; variation with different substances ; the heating of the atmosphere ; isothermal lines ; isotherial[1] and isochimatic[2] lines ; diminution of temperature with altitude and with latitude, and its relation to agriculture ; temperature of the sea ; of lakes and springs ; quantity of heat necessary for plants in order that they may fulfil their several vital acts.

Atmospheric pressure.—Barometer ; wind ; causes of barometric variation ; application to the forecasting of the weather.

Atmospheric humidity. Hygrometers and their use in relation to changes of the atmospheric state ; fogs, clouds, rain, snow, hail, dew, hoar frost, etc. ; pluviometers ; water precipitated from the atmosphere and its relation to vegetation ; the deforestation of mountains.

Atmospheric electricity.—Its effects ; precautions during storms ; lightning, lightning-rods, etc. Sunlight and its relation to vegetation ; rainbows, mirage, halos, etc. ; relation of these phænomena to the state of the atmosphere.

Zoology (2 hours).—This subject is treated in a somewhat different manner from what it is in Belgium. Commencing with the general notions of anatomy and physiology of man and domestic animals, the cell and its life is treated of ; principal animal tissues and membranes, and their properties ; osmosis ; digestion, with a description of the digestive apparatus and its functions ; the circulation of the blood, its nature and composition ; the pulse, fever, etc. ; phænomena of congestion and syncope ; hæmorrhage and bleeding ; the circulation of the lymph ; importance of this function for the health and development of animals ; what increases and what retards such circulation ; glands and obstructions ; respiration and chest capacity ; chest movement ; modification of the air ; the influence of oxygen ; of carbon-dioxide ; of carbon-monoxide, and of water-vapour ; animal-heat and assimilation ; secretion ; gland tissues ; milk-secretions ; secretion of fat ; excretion ; urine and the function of the skin ; transpiration and sweat ; sebaceous matter ; grease, hygiene of the function ; the production of hair and horn ; pigmentation ; albinism ; melanism ; importance of these phænomena in animals ; their causes in relation to various functions ; the nervous system and its functions ; the locomotor system and its functions ; animals useful for the Swiss agriculturist, their habits and classification ; guiding principles of their relative utilities.

Mammals,

[1] Isotherms which express the mean temperature for the summer season.
[2] Isotherms similarly expressing the mean temperature of the winter season.

Mammals, Cheiroptera, carnivora, insectivora, rodentia, rumantia, suidæ, equidæ; principal breeds; on domesticity in general; and on the development of such animals as are not taken in the course on zootechnics; dogs, hares, etc.

Birds.—Rapaces, diurnal, and nocturnal. Birds of economic importance are treated of; their development, incubation, breeds, etc.

General zootechnics (2 hours).—Besides a treatment of this subject in a general manner, somewhat similar to that indicated in the Belgian programmes, special attention is given to the question of care during gestation; the causes of abortion and monstrosity; the care to be given during second dentition; the influence of this period on the animal's development; of the fat during the plastic period; of castration of male and female; of the specialisation through selection and breeding; of the influence of consanguinity; its utility and inconveniences, the importance of animal pedigree; the influence of each parent in crossing; difficulties of maintaining the consistency of any breed submitted to crossing; general questions concerning digestion; feeding, and the care of domestic animals.

Second Year.

The subjects of the Second Year are as follows:—

Subject.	Hours per Week.	Subject.	Hours per Week.
1. General Agriculture	3	10. Dairying Industry	1
2. Apiculture	2	11. Civic Instruction	1
3. Arboriculture	2	12. Rural Legislation	1
4. Surveying	1	13. Agricultural Mechanics	2
5. Botany	2	14. Forestry	1½
6. Agricultural Chemistry	2	15. Viticulture	2
7. Agricultural Building	1	16. Zoology	2
8. Rural economy in Switzerland ...	2	17. Special Zootechnics...	3
9. Horticulture and Kitchen Garden ...	2	18. Special Course for Cattle Inspectors	1½

In the detailed programmes, these subjects are very methodically developed.

8. *Equipment of the Institut Agricole.*—This establishment has a considerable and well-equipped museum, a large experimental garden, the necessary laboratory apparatus, and it is well provided for teaching. A special feature of the Institute is, perhaps, the meteorological equipment.

9. *Lecture Notes.*—A detail of the teaching method in this school which struck the Commissioners as being of considerable value, was the use, to some extent, of a special form of note-book; for example, in the treatment of Agricultural implements and machines two note-books are used of about 260 or 270 pages in all. These are lithographed, and contain the headings, shewing the development of the subject, and give at the same time diagrammatic illustrations, while plenty of space is left for the student's own notes.

The two following examples will give a sufficient indication of the arrangement of the note-books.

Economic and Moral Effects of Machines.

Leads to abundance, and lowers the price of products. Saves from brutalising labour. The worker replaced. Economic harmonies of Bastian. The needs of Society increase unceasingly. (Examples).	Actual facts appear to be in disagreement with these principles. This is not due to the machinery. Mechanics has made less progress in Agriculture than in Industry. Causes which have hindered the introduction of Machinery in Agriculture. What may be urged in favour of Machinery.
The Wheel. Object of rolling. *Theoretical Study of the Wheel.* Different Species. Diameter. Weight. The resistance to rolling is in the inverse ratio of the diameter of the rolling body. [There is here a lithographed diagram shewing this geometrically.]	The line of traction must be inclined. [Illustrated diagram.] A small wheel compresses the soil more than a large one of equal breadth and weight. Duration of the pressure. A small wheel of the same weight and breadth as the larger one is more efficacious in breaking clods. Résumé. Raised shafts. [Illustrative geometrical diagram.] *Breadth*—The force of compression of a wheel is the inverse ratio of its breadth. Excessive breadth makes turning difficult. Etc., etc.

The

The student puts such notes as he thinks fit against these headings during the lecture, greatly saving his time, and helping him to make thoroughly systematic records.

As is common in Germany, the lectures are often lithographed in script, the necessary diagrams being on the pages with the text; the lectures are, in general, developed in a most systematic manner, and are well illustrated. By way of making this point clear, the figures for the lectures on "Agricultural Meteorology and Weather-forecasting" may be referred to. These lectures are given by the Professor, Henri Dufour, the Professor of Physics and Meteorology in the University of Lausanne.

Figures 1, 2, 3, shew the thermometers; 4, the method of installing them in a louvred structure, open on the north side in the northern hemisphere. Fig. 5 illustrates the variation of temperature in Summer, Autumn, and Winter, at different depths in a lake. Fig. 6 indicates how to install a thermometer for measuring the temperature of the soil. Fig. 7 illustrates solar variation. Fig. 8 is the Campbell and Stokes heliograph for the measurement of insolation. Fig. 9, the Pouillet pyrheliometer. Fig. 10, the actinometer. Fig. 11, the absolute hygrometer, viz., an apparatus for measuring the quantity of moisture taken up by sulphuric acid from a cubic metre of air passed through the acid by means of an aspirating pump. Fig. 12, shews the *pine-branch* used in country places as a relative hygrometer; and fig. 13, Saussure's hair-hygrometer. Figs. 14, 15, and 16 are repetitions, while 17 shews the proper method of installing a pluviometer (rain gauge). Fig. 18 gives the forms of snow crystals; 19, of hail; 20, Richard's self-registering barometer (aneroid). Fig. 21 illustrates three forms of mercurial barometer; fig. 22, the movement of a centre of depression and the direction of the wind which results therefrom, together with the state of the sky associated therewith, and the places where rain may be expected, and where it will cease. Fig. 23, shews similarly the movement of the centre of high pressure. Fig. 24, a cyclone; fig. 25, apparatus for observing the apparent velocity of clouds; fig. 26, apparatus for the direction of wind. Figs. 27 and 28 are anemometers; while fig. 29 represents the vertical circulation of wind at the shore of a lake. Fig. 30 illustrates the air-currents in mountains and valleys. Fig. 31 shews the method of installing lightning-conductors on houses; 32, refraction in water, and 32 and 33 the production of the rainbow by refraction, etc. Fig. 34 illustrates the production of parhelia; 35, the refraction in crystals of ice. A map shewing isothermal lines, and chart shewing the annual variation of temperature based on the mean for half a century, closed the illustrations of the lecture-course.

10. *Agricultural publications of Lausanne.*—At Lausaune is published the "*Chronique Agricole du Canton de Vaud,*" the organ of the Agricultural Institute. The publication is under the auspices of the Department of Agriculture, and is edited by M. S. Bieler, the Director of the Institute, to whom the Commissioners are under obligations for his kindly courtesy to them. The 1902 volume is that of the fifteenth year of publication, and the volume runs into about 650 pages of matter. The parts are issued fortnightly, and the subscription is only 2 francs for Switzerland, and 3 francs 50 cents. for all countries in the Postal Union. With the editor-in-chief are nine collaborators, viz., the

Professors of Chemistry and Physics in the University
Director of the Viticultural Station, a University professor
Chief of the agricultural experiment and analysis station
Secretary and Principal Gardener of the Agricultural Institute
Directors of the Seed-Control Station, and Dairying Station
Chief of the Forestry Department.

All matters concerning agriculture, viticulture, forestry, general agronomy, dairying, and the teaching of these subjects are treated in the Chronicle. For example, the question of the function of nitrobacteria, of the role of earth-worms, in connection with agriculture; the utility of bombarding clouds in order to prevent the formation of hail, the precipitation being in the form of rain instead; the influence of cutting and of the position when setting of the eyes of potatoes on the yield; fruit-drying; these and similar questions of either a scientific or practical character; are discussed in a suitable manner for the end in view, viz., the practical instruction of the agricultural part of the population.

Incidentally it may be mentioned that hail-cannon were noticed installed over very considerable areas in Switzerland for the purposes of protecting their vineyards. An illustration shews the installation of the cannon. Powder and an explosive mixture of acetylene are used for projecting vortices into the clouds, and also bombs which explode at 140 to 400 metres elevation. There have been in Italy rather numerous accidents, and not a few deaths, with the cannon. Statistics are given in the Agricultural Chronicle.

11. *School for Cheese-manufacture at Moudon.*—At Moudon, about 23½ miles from Lausanne, is a school for cheese manufacture (*école pratique de fromagerie*). There were actually two buildings at the time of the Commissioners' visit, the new one splendidly equipped. There is an *internat* at the school for students who remain one year at the course. The rooms of the school itself are a milk-room *laiterie*, with stream of water flowing about the milk receivers; and a steriliser, a cheese-making room with apparatus, a press-room, a maturing-room, an ageing room, and "caves" for storing the cheeses.

The battery had its shaft driven directly by electro-motor, and the installation both in respect of light and power was electric throughout.

The chemical laboratory is in the building where the Director had his quarters.

The course is organised scientifically, and the pupils learn all that is known of scientific facts affecting the art of cheese-making.

The new building was erected because of the success of the old "*école de fromagerie.*"

12. *Other forms of Agricultural Education.*—Besides what has been mentioned there are a number of schools variously organised for instruction in agriculture, viticulture, fruit culture, dairying, etc. Among these may be mentioned :—

(1) The Cantonal Agricultural School, Strickhof, Zürich. Entrance, 15 years of age. Course of from 3 to 4 semesters.

(2) German-Swiss Experimental Station and School for Fruit-culture, Viticulture, and Gardening at Wädensweil. Principal course, 8 months. Number of shorter courses.

(3) Agricultural School at Rüti, Berne. Two-year courses, with entrance age 16.

(4) Dairying and Cheese-making School, same locality.

(5) Agricultural Winter School at Lucerne, with 2 semester courses.

(6) Dairy and Dairy School (*école de laiterie*)at Pérolles-Fribourg.

(7) Winter courses, same locality, in Agriculture. Two winter semesters. Age of entrance, 16.

(8) Sonnenwyl Fribourg. School-farm. Two-year courses. Age of entrance, 15.

(9) The Sornthal Dairying School (St. Gall).

(10) The professional course of the Vaud "*Syndicat*" of Horticulturists.

(11) Chemical and Bacteriological Laboratory in Lausaune, with models and objects for the economics of dairying.

(12) Vevey "*école de viticulture.*" Beginning of March to end of December.

(13) Ecône Agricultural School, Valais. Two-years course (23-25 hours weekly).

(14) The Cernier *Ecole Cantonale d'Agriculture*, Neuchâtel. Two-year course.

(15) The Auvernier Viticulture Experimental Station and School.

(16) The Geneva *Ecole Cantonale d'Horticulture.* About 3 years. Entrance, 15½.

13. *Concluding remarks.*—To appreciate properly the Swiss system, it should be remembered that in the primary school there is often a distinct orientation of the scientific teaching in the direction of agriculture, and, further, that in the higher schools preparatory qualification is, in general, well secured. Hence attendance at the higher schools is profitable, and the student is able to derive the fullest possible benefit from the course.

CHAPTER XLIV.

CHAPTER XLIV.

The "Institut National Agronomique" of France.

Fundamental Sciences.

[G. H. KNIBBS.]

1. *Introduction.*—At the summit of higher agricultural teaching in France is the National Agronomic Institute (*L'Institut National Agronomique*) at Versailles. It is a little more than a quarter of a century old. Originally created by the law of 3rd October, 1848, and established in the royal domain, it was abruptly suppressed in 1852, and not reconstituted again till 9th August, 1876.

Lavoisier is credited with originating the idea of establishing truly scientific teaching in agriculture, and the first attempts in that direction date back as far as 1789. Mathieu de Dombasle created the first agricultural school worthy of the name in 1822 at Roville, near Nancy; in 1829 Auguste Bella founded the school of Grignon, and in 1830 Rieffel established near Nantes the school of Grand-Jouan. The first has disappeared, the second remains, and the third has been transferred to Rennes.

Boussingault defined the rôle of the higher teaching in agriculture when he expressed the idea that its progress is dependent on science, and when he said that a knowledge of agriculture should, descending from its highest planes, pass downward through every grade of the people to the humblest cultivator.

The French system is as follows:—The "Institut Agronomique" is charged with the teaching of the highest grade It is the centre of agricultural specialism and research.

Next below the Institut are the District Agricultural Schools (*Ecoles régionales d'agriculture*). The number of these, originally fixed at four, has risen to twenty. They afford both theoretical and practical instruction.

The third degree of instruction is given in farm-schools (*fermes-écoles*), which are specially designed for giving essentially *practical* instruction to the children of the smaller cultivators.

At the opening of the National Agronomic Institute, nine chairs were created, as follows:—

Chair.	Occupant.
1. Botany ...	M. Duchartre.
2. Zoology ...	M. Doyère.
3. Terrestrial physics, meteorology, geology ...	M. Becquerel.
4. Chemistry ...	M. Wurtz.
5. Rural-Engineering ...	M. Barré de Saint-Venant.
6. Agriculture ...	M. Boitel.
7. Forestry ...	M. Tassy.
8. Zootechnics ...	M. Baudement.
9. Rural economics...	M. de Lavergne.

Almost immediately the chair in chemistry was divided, M. Wurtz being professor in general chemistry and analyst, and M. Georges Ville, professor in agricultural chemistry.

This professorial body will indicate at once the great calibre of the institution, and from the first the instruction given and the work done in the Institute was of the highest character.

2. *Conditions of entrance.*—It is well that we should realise the great gap between our institutions and those of Europe. To this end it is necessary to have regard to the knowledge required for entrance into the Institute. This as indicated hereunder:—

"Institut National Agronomique de France."

PRELIMINARY KNOWLEDGE REQUIRED ON ENTRANCE.

I.—Arithmetic.

Decimal numeration.
Addition and subtraction of whole numbers.
Multiplication of whole numbers. Product of several factors. Fundamental theorem and its consequences.
Division of whole numbers. Theorems relating to division.
Remainders from division of a whole number by 2, 5; 4, 25, 8, 125; 9, 3. Characters of divisibility by each of these numbers.
Greatest common measure of two numbers. Ascertainment of the greatest common measure by the method of successive divisions. Numbers prime to each other. Every number which divides a product of two factors, and which is prime with respect to one of the factors divides the other.
Least common multiple of two numbers.
Definition of prime numbers. Elementary properties. Decomposition of a whole number into a product of prime factors.
Composition of the greatest common divisor, and of the least common multiple of several numbers resolved into their prime factors.
Ordinary fractions. Reduction of a fraction to its simplest form. Reduction of several fractions to the same denominator. Least common denominator. Operations with ordinary fractions. Extension of the theory to fractions of which the two terms are ordinary fractions.

Decimal

Decimal numbers. Operations treating decimal fractions as particular cases of ordinary fractions. Calculation of a product or quotient to a given degree of approximation. Reduction of an ordinary to a decimal fraction. Condition of possibility. Periodic decimal fractions (Repeating decimals). Square of a whole or fractional number. Composition of the square of the sum of both numbers. The square of a fraction is never equal to a whole number. Definition and extraction of the square root of a whole number less than unity. Definition and extraction of the square root of a whole or fractional number to a given approximation. Metric system. Ratio of two numbers. Equal proportions. To divide a number into parts proportional to given numbers. Measurement of magnitudes. Definition of the proportion of two magnitudes of the same kind. Theorem; the ratio of two magnitudes of the same kind is equal to the quotient of the numbers which measure them. Magnitudes which are directly or inversely proportional. Simple or compound rules of three. Simple interest. Discount. Questions concerning mixtures and alligation. Definition of absolute and relative error. Synopsis of the theory of relative error. Numerical applications.

II.—Algebra.

Introduction of negative numbers. Examples: Positions of a point upon an axis, formula for uniform motion. Operations with negative numbers. Algebraic fractions. Extension of properties demonstrated in arithmetic.

Algebraic expressions. Monomials. Polynomials. Similar terms.

Algebraic operations. Addition, subtraction, and multiplication of polynomials. Division of monomials. Exponent 0. Division of two polynomials with reference to the decreasing powers of terms denoted by the same letters.

Equation of the first degree. Equation of the first degree with one unknown. Equation of the first degree with several unknowns. Various methods of solution. Solution and discussion of two equations of the first degree with two unknowns. Statement of problems in form of an equation. Discussion of results. Numerical inequalities. Inequalities of the first degree.

Equation of the second degree. $ax^2+bx+c=0$. (The theory of imaginaries is not included.) Relation between the coefficients and roots. Nature and signs of the roots. Study of the trinomial of the second degree. Variations of sign. Inequalities of the second degree. Variation of the magnitude of a trinomial; graphic representation. Biquadratic equation. Biquadratic trinomial.

Problems of the second degree. Questions of maximum and minimum which may be treated by the solution of an equation of the second degree. Variation of the quotient of two trinomials of the second degree; graphical representation (numerical examples). Arithmetrical and geometrical progressions. Sums of the squares of the first n whole numbers. Common logarithms. Definition and properties. (Only the numbers which put in the form of a geometrical progression need be considered.) Use of the tables to five decimal places. Compound interest. Amortization. Problems.

III.—Geometry.

Plane Figures. Straight line and plane. Angles. Perpendiculars. Triangles. Isosceles triangle. Case of equality of triangles. Perpendicular and oblique lines. Right-angled triangles. Case of equality. Definition of geometrical locus. Geometrical locus of points equidistant from two points or from two straight lines. Parallel lines. Sum of the angles of a triangle, of a convex polygon. Parallelograms. Figures that are symmetrical in relation to a point or a straight line. Two plane symmetrical figures are equal. Translation of a plane figure of invariable form. Composition of several translations. Use of the rule and square.

Circle. Intersection of a straight line and circle. Tangent to the circle; the two definitions of the tangent. Arcs and chords. Relative positions of two circles. Measures of angles. Motion of rotation about a point. Every displacement of a plane figure of invariable form, in its own plane, may be produced by a rotation and a translation. Use of the rule and compass. Protractor. Geometrical loci.

Proportional lines. Every line parallel to one of the sides of a triangle divides the other two sides proportionally. Reciprocal theorem. Properties of the bisectors of a triangle. Geometrical locus of points of which the distance-relation to two fixed points is constant. Similar triangles. Cases of similitude. Homothetic figures. Centre of similitude of two circles. Similar polygons. Metrical relations in a right-angled triangle and in any triangle whatsoever.

Proportional lines in the circle. Power of a point with reference to a circle. Radical axis. Radical centre. Divide a straight line into parts proportional to given straight lines.

Fourth proportional; mean proportional. Division of a straight line in mean and extreme ratio. Regular polygons. Show that there may exist regular polygons with any number of sides whatsoever. The inscribing of the square, hexagon, equilateral triangle, decagon, pentagon, etc. Two regular polygons with the same number of sides are similar. Ratio of their perimeters.

Length of a circular arc. Ratio of the circumference to the diameter. Approximate value of π. (No question on the determination of this value other than by the method of the perimeters or by that of isoperimeters will be put.)

Area of polygons, area of the circle. Measure of the area of a rectangle, parallelogram, triangle, trapezium, or any polygon whatsoever. The square on the hypothenuse of a right-angled triangle is equivalent to the sum of the squares on the sides containing the right-angle. Relation of the areas of two similar polygons. Area of a regular convex polygon. Area of a circle, of a sector, and of a segment of a circle. Ratio of the areas of two circles. Synopsis on general ideas of surveying. Use of the chain and the cross-staff.

Figures in Space. Plane and straight line. Determination of a plane. Straight line and perpendicular planes. Properties of the perpendicular and oblique lines drawn from the same point to a plane. Parallelism between straight lines and planes. Dihedral angles. Right dihedral. Plane angle corresponding to a dihedral angle. The ratio of two dihedral angles is the same as that of their plane angles. Perpendicular planes.

Trihedral angles. Each face of a trihedron is less than the sum of the two others. Limit of the sum of the faces of a trihedron. Supplementary trihedrons.

In every trihedron, each dihedral plus two right angles is greater than the sum of the two others. Limits of the sum of the dihedrals of a trihedral angle. If the edges of any trihedral angle whatsoever be prolonged beyond its vertex a new trihedral angle is formed which cannot be superimposed upon it but is nevertheless composed of the same elements. Exact definition of the elements of a trihedron. Cases of equality of trihedrons.

Sum of the faces of a convex polyhedral angle.

Polyhedrons. Parallelepiped. Volume of a right-angled parallelepiped. Volume of a right prism, of an oblique parallelepiped, of an oblique prism. Pyramid. Volume of the pyramid. Volume of the truncated sections of the pyramid, with parallel bases.

Homothetic polyhedrons. Similar polyhedrons. Ratio of the volumes of two similar polyhedrons. Translation of a figure of invariable form in space. Rotation about an axis.

Symmetrical figures. Symmetry with regard to a point.

Symmetry with regard to a plane. Relation between the second mode of symmetry and the first. Symmetry in relation to a straight line.

Two symmetrical polyhedrons are equivalent.

Right cylinder with circular base. Lateral surface. Volume.

Right cone with circular base. Sections parallel to the base.

Lateral surface of the cone, of a truncated cone with parallel bases. Volume of a cone, and of a truncated cone with parallel bases.

Sphere. Plane sections, great circles, small circles. Poles of a circle. Given a sphere to find its radius by a plane construction.

Tangent Plane. Measure of the surface generated by a regular bent line turning about one of its diameters. Area of the zone. Area of the sphere. Measure of the volume generated by a triangle turning about an axis taken in its plane, through one of its vertices. Application to the volume generated by a regular polygonal sector turning about one of its diameters.

Volume of a sphere. Volume of a spherical segment.

The ellipse and the parabola.

Ellipse. Definition of the ellipse by its focal properties. Drawing

Drawing the curve by means of points, and by continuous motion. Axes. Vertices. Directrix circle. Intersection of a straight line with an ellipse. Tangent. Normal. To draw tangents to an ellipse : (1) From a given point ; (2) parallel to a given straight line,

Parabola. Definition of the parabola by its relation to its focus and its directrix. Drawing the curve by means of points and by continuous motion. Axis. Vertex. Intersection of a straight line with a parabola. Tangent. Normal. Sub-normal. To draw a tangent to a parabola : (1) From a given point ; (2) parallel to a given straight line. Relation between the square of a chord perpendicular to the axis and its distance from the vertex.

The Helix. Definition. Property of the tangent.

IV.—Trigonometry.

Trigonometrical lines. Relations between the trigonometrical lines of one and the same arc. Calculation of the trigonometrical lines of several arcs, viz., $\pi/4$, $\pi/3$, etc.

Theorem of projection. Formulae of addition for the sine, cosine, and tangent, derived from the theory of projection. Expression for $\sin 2a$, $\cos 2a$, $\tan 2a$.

All the trigonometrical lines of the arc a are expressed rationally as a function of $\tan 1/2\ a$.

Given $\cos a$, or $\sin a$, to calculate $\sin\ \frac{1}{2}a$ and $\cos\ \frac{1}{2}a$.

Given $\tan a$, to calculate $\tan \frac{1}{2}a$.

To a transform into a product the sum of two trigonometrical lines, sine, cosine, or tangents.

Limit of $\sin x/x$ when x tends towards 0.

Use of the trigonometrical tables of five places.

Relations between the angles and the sides of a triangle.

Solution of triangles. Application of trigonometry to various questions relative to the preparation of plans.

Solution and discussion of several simple trigonometrical equations.

Trigonometrical resolution of an equation of the second degree.

V.—Descriptive Geometry.

Insufficiency of ordinary drawing for the representation of bodies.

Utility of a geometrical method which, by the execution of graphical constructions on one and the same plane, makes it possible to exactly define the form and position of a figure.

Projection of a point, of a straight line, of any line whatsoever upon a plane. Horizontal and vertical planes of projection.

Representation of a point, of a straight line, and of any line whatsoever, by their horizontal and vertical projections.

Representation of a plane.

Problems relative to the straight line. To determine the path of a given straight line from its projections. To find the projections of a straight line when its position is given. To draw through a point a line parallel to a given straight line. By means of their projections to ascertain whether two given straight lines cut one another.

Problems relative to the plane. Draw a plane : (1) through three points ; (2) through two straight lines that intersect ; (3) through two parallel lines ; (4) through a point and a given line. To draw through a point a plane parallel to a given plane. To determine the intersections of two planes. To determine the point common to three planes.

Problems relative to the straight line and plane. Determine the point of intersection of a straight line with a given plane. To ascertain on a diagram if a given straight line be in a given plane. To draw through a point a straight line parallel to a given plane, and meeting a given straight line. To draw through a point a straight line touching two given straight lines. To draw a straight line in a given direction touching two other straight lines.

Straight lines and perpendicular planes. Necessary and sufficient condition in order that a right angle may project upon a plane. To draw through a point a straight line perpendicular to a plane. To draw through a point a plane perpendicular to a given straight line. To draw through a point a straight line perpendicular to a given straight line.

Methods of Rotations (the axis being supposed perpendicular to one of the planes of projection).

Change of one of the planes of projection.

Method of rebatement. Application of the method to the following questions :—

(1) *Determination of distances.* Distance of two points. Distance from a point to a plane. Distance from a point to a straight line. Shortest distance between two straight lines.

(2) *Determination of angles.* Angles between two straight lines. Angle between a straight line and a plane. Angles between a straight line with the planes of projection. Angle of two planes. Angles of a plane with the planes of projection.

Projection of a prism of a pyramid. Visible and hidden parts. Plane sections of these polyhedrons. Projections of a circle. Projection of a helix upon a plane parallel to its axis.

Elevations. Representation of the straight line of the plane. Elementary problems concerning the straight line and plane. Exercises on the representation of simple polyhedrons. Platforms with sloping sides ; heap of sand, etc.

Elementary ideas concerning the topographical surfaces : contour lines of greatest slope ; lines of equal slope.

VI.—Mechanics.

Elements of Statics.

The idea of forces. Equal forces. Numerical evaluation of a force. Two equal and contrary forces applied to two points in a straight line of invariable length and acting in the direction of that line are in equilibrium. Translation of the point of application of force to any point whatsoever taken upon its line of action, and supposed to lie invariably in the first.

Composition of two forces applied to the same point. Theorem of moments in regard to a point taken in the plane in which the forces act.

Composition of any number of forces whatever applied to the same point. Condition of equilibrium. Composition of two parallel forces.

Couple. A couple has no resultant. Composition and decomposition of couples.

Composition of any number whatsoever of parallel forces. Centre of parallel forces. Its ascertainment in several simple cases. Triangle, trapezium, quadrilateral, prism, and pyramid.

Composition of any system whatever of forces applied to a solid body. Their reduction to a single force and a couple. The general condition of equilibrium. Conditions of equilibrium when the body upon which they act is not wholly free. Particular case where the body may move about a fixed point or about a fixed axis, or where it lies upon an immovable plane.

Simple Machines.

Lever. General condition of equilibrium of the lever.

Balances. Ordinary balance, Roman balance, Roberval's balance, Quintenz's balance.

Pulley. Equilibrium of the fixed pulley. Equilibrium of the movable pulley. Pulley blocks.

Wheel and axle. Equilibrium of the condition of the wheel and axle. Winch.

Inclined plane. Equilibrium of body placed upon an inclined plane.

VII.—Cosmography.

Celestial sphere. Principal constellations. Diurnal movement. Right ascension and declination.

Spherical form of the earth. Determination of longitude and latitude. Radius of the earth. Geographical maps.

The sun. Apparent movement in the celestial sphere. Ecliptic ; zodiacal constellations. Inequality of days and nights Seasons. Their inequality. Measurement of time. The calendar.

The moon and its phases.

Eclipses of the moon and of the sun.

General description of the solar system. Planets and their satellites. Kepler's Laws. The system of Copernicus.

Succinct account concerning the various planets.

Comets, meteors, star-clusters, nebulæ.

VIII.

VIII.—Physics.

Various states of matter. Weight. Law of the fall of bodies. Attwood's machine. Morin's machine. The proportionality of force to the acceleration produced by it. Mass: its measure by means of weight.
The pendulum and its application.
The principles of inertia. Forces.
Direction of gravity. Centre of gravity, weight. Balance.
Equilibrium of liquids and of gases.
Transmission of pressure in fluids. Pascal's principle.
Free surface of liquids in equilibrium. Pressure upon the bottom and sides of vessels. Communicating vessels. Hydraulic press.
Principle of Archimedes, specific weight, areometers.
Atmospheric pressure. Barometer.
Mariotte's Law. Manometers. Mixture of gases. Air-pump, ordinary pumps, syphons, aerostats.

Heat.

Dilatation of bodies by heat. Thermometer. Definition and use of coefficients of dilatation.
Maximum density of water.
The density of gases. Regnault's processes.
Specific heats of solids and liquids. Principle of the method of mixtures.
Fusion and solution. Solidification. Heat of fusion. Refrigerant mixtures.
Evaporation. Formation of vapour *in vacuo*. Saturated and non-saturated vapour. Maximum elastic tension of water-vapour at various temperatures. Mixture of gas and vapour. Evaporation. Ebullition. Distillation.
Heat of evaporisation.
Mechanical equivalent of heat. Steam-engine. Condenser. Expansion engine.
Hygrometry. Hygrometry of condensation.
The conception of conductivity. Ordinary applications.

Acoustics

Production and propagation of sound, velocity of sound in air.
Reflection of sound. Echo.
Intensity. Pitch, musical intervals.
The transversal vibration of strings. Harmonics, timbre.

Optics

Rectilinear propagation of light. Velocity, omitting description of the mode of measurement.
Comparison of intensity of two different lights.
Laws of reflection. Plane mirrors. Spherical mirrors. Concave and convex mirrors.
Laws of refraction. Prisms, lenses.
Composition of white light. Dispersion. Solar spectrum. Spectra of different luminous sources.
Magnifying glass. Compound microscope. Astronomical telescope. Galileo's telescope. Newton's telescope.
Chemical action produced by light. Brief summary of the ideas concerning photography.
Radiant heat. General ideas concerning the phænomena of emission, transmission, reflection, and absorption. Identity of radiant heat and light.

Electricity and Magnetism.

Electiification by friction.
Enunciation of the law of electric attraction and repulsion.
Distribution of electricity on the surface of conductors.
Power of points.
Elementary ideas, purely experimental in regard to electric, potential, and capacity.
Electrification by influence. Electroscopes. Electrophorus. Electric machines.
Condensation. Leyden's jars. Batteries. Electroscope condenser.
Lightning and lightning conductors.
Natural and artificial magnets. Poles.
Definition of declination and inclination. Ordinary compasses.
Magnetisation by simple contact.
Experiments of Galvani and of Volta. Voltaic pile. Chemical effects of currents. Cells of constant current.
Experiment of Oersted. Galvanometer.
Enunciation of the fundamental laws of electric currents. Practical units of intensity, resistance, and electro-motive force.
The action of currents upon currents and upon magnets. Solenoids. Magnetisation by electric current. Telegraphy.
Thermo-electric currents.
Electric induction. Fundamental experiments. Principle of magneto and dynamo electric machines. Reversibility o these machines.
Telephone.
The calorific and luminous effect of currents. Voltaic arc and incandescent lamp.
Galvanoplastics. Electro-plating with gold and silver.

IX.—Chemistry.

Numerical laws of chemistry. The law of simple proportions of multipleproportions. Law of Gay-Lussac. Law of proportionality. Richter's law. Proportional numbers. Atomic weights. Molecular weights.
Hydrogen, its preparation and properties.
Oxygen, its preparation and properties. Ozone.
Water. Physical properties. Synthesis by the Eudiometric method.
Synthesis by means of oxide and copper. Analysis by the electric cell. Chemical properties of water. Potable waters.
Peroxide of hydrogen or oxygenated water. Mode of preparation. Physical and chemical properties.
Nitrogen. Preparation and properties
Air: its analysis. Principal constituents contained in the atmosphere.
Combination of nitrogen with oxygen. Protoxide of nitrogen. Preparation, properties, and analysis. Nitrous acid, preparation, and properties.
Nitric acid. Synthesis by the electric spark. Nitrification. Preparation, properties.
Nitric anhydride.
Ammonia. Origin of ammoniacal compounds. Preparation from an ammoniacal gas and its aquous solution. Physical and chemical properties of gaseous ammonia. Its composition.

Chlorine.

Preparation of chlorine in laboratories and in the Arts. Physical and chemical properties.
The combinations of chlorine with oxygen. Hypochlorous and chloric acids.
Hydrochloric acid. Direct combination of chlorine with hydrogen under the influence of sunlight. Properties of hydrochloric acid gas. Preparation of hydrochloric acid in laboratories and in the Arts. Its composition.

Bromine.

Extraction, properties, hydrobromic acid.

Iodine.

Extraction, properties of hydriodic acid.

Fluorine.

Fluorine.

Hydrofluoric acid.

Sulphur.

State in which it is found in nature. Extraction and purification of natural sulphur. Physical and chemical properties. Combination of sulphur with oxygen. Sulphurous acid. Various modes of preparing this gas. Physical and chemical properties.
Sulphuric acid.—Nordhausen's fuming sulphuric acid. Sulphuric anhydride. Preparation of the hydrated sulphuric acid in the arts. Properties of mono-hydrated acid.
Hydro-sulphuric acid and hypo-sulphuric acid. Conditions in which they form their sodium salts.
Sulphuric acid : its preparation and chemical and physical properties. Its composition.

Phosphorus.

Processes of extraction. Physical and chemical properties. Combinations with oxygen. Phosphoric acid.
Phosphorous acid. Hypophosphorous acid.
Phosphoretted hydrogen. Chlorides of phosphorus.
Arsenic. Arsenious acid. Arsenic acid. Arsenuretted hydrogen. Marsh's apparatus. Sulphide of arsenic.
Antimony. Oxide of antimony. Sulphides of antimony. Kermes mineral. Chlorides of antimony. Antimoniated hydrogen.
Analogy between arsenic and antimony.
Boron. Boric acid.
Carbon. Natural states of carbon. Physical properties of different forms of carbon. Chemical properties of carbon.
Carbon monoxide. Preparation and physical and chemical properties.
Carbon dioxide. Circumstances under which it is produced in nature. Action of plants upon the carbon dioxide of the atmosphere. Preparation, and physical and chemical properties.
Sulphide of carbon ; its preparation and properties.
Silicon : Silica, silicated hydrogen. Chloride of silicon. Silicon fluoride. Hydrofluosilicic acid.
Résumé. Classification of the metalloids in natural families.

Metals.

Metals in general. Properties, classification, alloys.
Principal modes of production of the metallic oxides. Action of heat, of carbon and water.
Chlorides, sulphides, salts, general properties.
Action of acids, of bases, and of salts upon salts. Principal kinds of salts. Nitrates, sulphates, carbonates.
Potash, soda, sea-salt, nitre and powder, alums, carbonate of potassium and of sodium.
Lime, carbonate of lime.
Iron, principles of the metallurgy of iron, cast-irons and steels.

X.—Zoology.

General characters of the animal kingdom. Notions upon the organic tissues of animals. The organisation of animals.

(1) *The functions of nutrition.*

Digestion.—Digestive apparatus of the mammals. Brief description of this apparatus. The buccal cavity. The teeth : their composition. Various kinds of teeth. Pharynx. Œsophagus ; stomach ; intestines ; salivary glands ; pancreas ; liver. Chemical phænomena of digestion.
Absorption : its organs.
Brief notions regarding the modification of the digestive apparatus in the animal series.
Circulation.—The blood ; its composition. The circulatory apparatus in the mammals. Heart, arteries, veins, capillary vessels. Brief ideas regarding the modification of the circulatory apparatus in the reptiles, batrachians, fish, mollusca, and insecta.
Respiration.—Theory of respiration. Respiratory apparatus of mammals. The nasal fossa. Larnyx ; trachea ; bronchi ; lungs. Mechanism of respiration.
Summary of the ideas regarding the modifications of the respiratory apparatus in birds, reptiles, batrachians, fish, mollusca, and insecta.
Excretory apparatus.

(2) *The functions of relation.*

The osseous system. The vertebrates. Human skeleton. The essential modifications in the vertebrates. Articulation.
Muscular system. Properties of muscles. Locomotion.
Nervous system in mammals. The cerebro-spinal system. The brain ; spinal cord ; nerves ; nerve ganglions. The sympathetic ganglionic system.
Notions concerning the modification of the nervous system in birds, reptiles, batrachians, fish, mollusca, and insecta.
The sense-organs in the mammals. Their structure and function. Touch, taste, smell, hearing, vision.
Brief summary regarding their modification in birds, fish, mollusca, and insecta.

(3) *Classification.*

General notions : Definition of branches. Sub-branches. Classes, orders, families, genera, and species.
General characteristics of the five classes of vertebrates ; mammals, birds, reptiles, batrachians, and fishes.
General characteristics of the mollusca and insecta : their division into orders.

XI.—Botany.

General characters of plants.
Structure of a plant-cell ; its modifications. Fibres, vessels, living and dead tissues.
The organisations of plants. Cryptogamic plants. Cellular and vascular cryptogams. Phanerogamic plants. Gymnosperms and angiosperms. Monocotyledons and dicotyledons. Difference in the structure of the embryo.
Stems of the phanerogams. Structure and annual growth of woody stems.
Root. Structure of roots. Difference between the structure of roots and that of stems. Development of roots, their functions.
Leaves. Structure of leaves. Leaf-nerves. Green parenchyma.
Structure and rôle of chlorophyll, Nutrition of plants with chlorophyll. Plants without chlorophyll. Parasitism.
Reproduction of phanerogams. Flower, floral envelopes, stamen, anther, pollen, pistil, carpel, ovule.
Fecundation, fruit and grain, germination.
Reproduction in the cryptogams. Sexual reproduction. Asexual reproduction. Spores, zoospores.

XII.—Geology.

(1) *Study of actual geologic phænomena.*

Degradation of continents under the influence of air and water. Water derived from infiltration, springs. Flowing waters. The formation of valleys. Accumulations of fresh water. Deltas. Action of water in a solid state. Glaciers. Moraines and erratic blocks. Action of the sea. Marine deposits and organisms which contribute to their formation. The coral reefs.
Volcanic phænomena, volcanos, thermal springs. Earthquakes.
Materials in the crust of the earth. Various ideas concerning the principal eruptive and sedimentary rocks. Fossils.

(2) *Systematic Geology and brief summary of Palæontology.*

Classification of the sedimentary regions.

Primary period. The animal kingdom. Polyps, trilobites. Insects of the Coal Measures. Cephalopods, brachiopods, vertebrates. Flora of the carboniferous period.

Study of the systems of the primary period. Pre-Cambrian. Silurian. Devonian. Carboniferous. Permian. Primary eruptions.

Secondary period. The animal kingdom. Polyps (coral reefs). Echidnus. Molluscs. The Lamellibranchia, and cephalapoda (ammonites and belemnites), Brachiopoda. Great development of reptiles. Birds, mammals, appearance of angiosperms.

Study of the systems of the secondary period. Triassic, jurassic, cretaceons, and their several stages.

Tertiary period. Foraminfera (nummulites.) Molluscs and their fresh water types. Vertebrates and development of the mammals. Their connection with actual types. History of the development of the horse. Vegetable kingdom and climate. Study of the systems of the tertiary period. Eocene, oligocene and their stages, miocene, pliocene. Development of the great mountain chains. Tertiary eruptions in France.

Quaternary period. Appearance of man. Fauna. Glaciers and their extension. The formation of valleys.

XIII.—Physical and Economic Geography.

The earth and its various movements. Poles, great circles, longitude, latitude, geographical distances.

Division of the earth's surface into two parts. Ocean and continent.

Ocean: its division into five parts. Tides, currents.

Continent: its division into five parts, populations, races.

Europe. The six great European States. The secondary States.

Study of the seas of Europe. Shores, islands, straits, etc.

Division of Europe by great mountains. Altitude and character of the mountain masses (the Alps and the Hercynian mountain system are given prominence).

Principal railroads.

France. Geographical situation; its longitude, and latitude and boundaries.

Physical geography. Seas, their description, shores and islands.

Orography. Pyrenees, Alps, Dura, Vosges, Central Plateau, Cevennes and secondary mountain masses. Principal peaks.

Hydrography. Detailed description of the region traversed by the Rhine, the Muse, the Scheldt, the Somme, the Seine, the Orne, the Vilaine, the Loire, the Charente, the Garonnne, the Adour. The Rhône and its principal tributaries. Description of the basins of the North Sea, the English Channel, the Bay of Biscay, and the Mediterranean.

Political Geography. Frontiers, their position. Ancient provinces, departments into which they have been formed. Administrative divisions.

Railroads. Great lines: their connection with one another, and with the principal network of foreign railways.

Interior navigation. Navigable and canalised rivers. Canals: their connection with the great highways of foreign navigation.

Asiatic, African, American and Oceanic colonies. Algeria. Physical and political description. Extent and limits. Boundaries. Orography and hydrography. Elevated plateaus. Sahara. Political divisions. Principal railroads.

Thorough study of the regions traversed by the Scheldt, the Muse, the Rhine, the Weser, the Elbe, the Oder, the Vistula, and the Nieman. A brief study of other watercourses in the North of Europe.

Thorough study of the regions traversed by the Ebro, the Po, and the Danube. Brief study of other rivers of the Mediterranean slopes.

Boundaries, populations, races, religions, government, political divisions. Commercial and industrial wealth of various European States.

Asia.—Description of its seas, shores, islands, capes, orography, hydrography, and political divisions.

European Colonies.—Empire of India, Cochin China, Tonkin, Annam (brief sketches only).

Africa.—Description of its seas, shores, islands, capes, etc. Its orography and hydrography. Political divisions. European colonies. Algeria. Tunis. Tripoli. Madagascar. (Brief accounts)

America.—Description of its seas, shores, islands, capes, etc. Orography and hydrography. Political divisions. European colonies. Detailed study of the United States.

Oceania.—Archipelago and islands European colonies.

XIV.—Living Languages (English or German).

The candidates are required to know the principal rules of the grammar of the foreign language which they have selected, to be able to explain the text of a book open at sight, and to reply in the language to questions addressed by the examiner, or to express himself orally.

It will be seen from the above, translated by the Commissioner from the official programme, that the student entering the National Institute of Agronomy has had a preliminary education on a sufficiently broad scientific basis to ensure his thoroughly profiting by the course of study undertaken in the Institute. *One cannot insist too strongly on the very marked difference in the state of preparation for advanced courses in England and in the English colonies, and the state of preparation in Europe.* It should be borne in mind also, that this degree of education is supposed to be reached at the age of 20 years, and it compares favourably with the state of preparation in any part of Europe.

The breadth and thoroughness of the science teaching is the secret of the marked characteristics of Europe. The scientific spirit is manifested in the life of the people in a way it is not with us.

3. *The Course in the Institute.*—The principle followed in the instruction given in the Agronomic Institute is, that the study of the sciences applied in agriculture must *precede* the study of Agronomy itself. The course of study may be divided into three distinct parts, viz.:—

(1) In the 1st semester of the 1st year the students receive advanced teaching in the sciences that are applied in agriculture.

(2) During the second semester of the same year, the students receive instruction in the *Art* of Agronomy. They are engaged in thoroughly practical work, but it is practice based upon the most advanced scientific knowledge, and is kept in touch therewith.

(3) In the second year, and during vacations, the students receive very complete practical instruction in agriculture, and visit agricultural stations and works.

These three sections are denominated—

(i) The study of the fundamental sciences of Agronomy.
(ii) Instruction in Agronomy.
(iii) Practical Agriculture.

With a view to affording complete information as to the course, and to shewing *how vastly superior the course is to anything yet given, or that under present conditions can be given, in Australia,* the programme is somewhat fully outlined in the sections following on hereinafter.

4. *Study of the fundamental sciences of Agronomy.*—These studies comprise the following, viz. :—

I.—NATURAL SCIENCE.

(a) *The Biology of Plants cultivated in France and her colonies.*

The *Professor* in this department is Ph. van Tieghen, Member of the Institute, Professor for the Museum of Natural History.

The *Chief of Works* and "*Répétiteur*" is G. Fron, Doctor of Science, Agronomical Engineer (*Ingénieur Agronome*).

(b) *General Physiology.*

The *Professor* is Dr. P. Regnard, Member of the Academy of Medicine, and of the National Society of Agriculture in France, Honorary Director of the School of Advanced Study, Director of the National Agronomic Institute.

The *Répétiteur* is Dr. P. Portier, Licencié-ès-Sciences, Préparateur at Sorbonne.

(c) *Zoology applied to Agriculture.*

Professor—Dr. P. Marchal, Doctor of Science.

Répétiteur—Mons. Guénaux, Agronomical Engineer.

(d) *Geology applied to Agriculture.*

Professor—Mons. Cayeux, Doctor of Science, Chief of the Practical Geology in the National School of Mines, Collaborator in the Service of Geologic Survey of France.

Répétiteur—Mons. Richard, Engineer in Arts and Manufactures.

(e) *Vegetable Pathology.*

Maître de Conférences—Dr. Delacroix, Director of the Station for Vegetable Pathology, Professor at the National Higher School of Colonial Agriculture, Professor in the School of Application of State Manufactures.

II.—PHYSICAL AND CHEMICAL SCIENCE.

(a) *Physics and Meteorology.*

Professor—M. Angot, Doctor of Science, *Agrégé* in Physical Science, Chief of Service in the *Bureau Central Météorologique de France.*

Répétiteur—Mons. Dongier, Doctor of Science, *Agrégé* in Physical Science, Sub-Director of the Physical Laboratory at Sorbonne.

(b) *Applied Chemistry (Investigation and Analysis).*

Professor—Mons. A. Muntz, Member of the Institute, and of the National Society of Agriculture of France, in charge of the Chemical Laboratories.

Chief of Chemical Laboratory Work—Mons. A. Ch. Girard, Professor in charge of Laboratory Work under the Director of the Laboratories.

Assistant—Mons. Condon, Agronomical Engineer.

Préparateur—Mons. Laveyrie, Agronomical Engineer.

(c) *Agricultural Chemistry.*

Professor—Mons. G. André, Doctor of Science, Agrégé Professor in the Faculty of Medicine.

Répétiteur—Mons. Demoussy, Doctor of Science.

(d) *Applied Organic Chemistry* (in the productions of Agricultural Industries).

Maître de Conférences—M. André Bidet, Professor in the School of Physics and Chemistry.

III.—MATHEMATICAL SCIENCE.

(a) *Mathematics.*

Professor—Mons. Laurent, Doctor of Medicine, Examiner for Admission to the *Ecole Polytechnique.*

Répétiteur—Mons. Homery.

(b) *Mechanics and Agricultural Hydraulics.*

Professor—M. Hérisson, Agronomical Engineer, Inspector-General of Agricultural Instruction, etc., former pupil in the *Ecole Polytechnique.*

Chief of Works—M. Vuaillet, Engineer in Arts and Manufactures.

Répétiteur for Mechanics—M. Thévennin, Engineer-in-Chief for the Post and Telegraph Service, Professor at the School for Advanced Commercial Studies, former pupil of the *Ecole Polytechnique.*

Répétiteur for Agricultural Hydraulics—M. Pélissier, Licencié-ès-Sciences Mathématiques, Professor at the *Ecole Coloniale.*

(c) *Mathematics and Topography.*

Maître de Conférences—M. Pélissier. (See above.)

(d) *Graphic Drawing and Topography.*

Professor—M. Muret, Honorary Geometer to the City of Paris.

Chief of Graphic Work—M. Vuaillet, Engineer of Arts and Manufactures.

IV.—SOCIAL SCIENCE.

(a) *Rural Legislation and Administrative Rights.*

Professor—M. Gauwain, Deputy Governor of the Crédit Foncier of France, Maître des requêtes honoraire au Conseil d'Etat, Member of the National Society of Agriculture of France.

Maître des Conférences et Répétiteur—M. Chapsal, Maître des requêtes au Conseil d'Etat.

(b) *Rural Economy.*

Professor—Mons. Convert.

Répétiteur—M. Tardy, Agronomical Engineer, Secretary of the Agricultural Section of the Social Museum.

(c) *Agricultural Accountancy.*

Maître des Conférences—M. de Sauvage.

(d) *Political Economy.*

Maître de Conférences—M. Souchon, Professor in the Faculty of Law in the University of Paris.

Each teacher is the author of a large number of original contributions to Science and a man of recognised standing. For example, M. Angot, between say 1880 and 1902, has published over 150 original contributions in various scientific papers.

5. *Study of Agronomy.*—The studies in Agronomy are similarly subdivided and comprise the following:—

I.—AGRICULTURE.

Professor—M. Schribaux, Agronomical Engineer, Direction of the Station for Seed-testing, Member of the National Society of Agriculture of France.

Chief of Works, 1*st year*—M. Boitel, Agronomical Engineer; 2*nd year*—M. Hitier, Agronomical Engineer, Maître de Conférences.

II.—ZOOTECHNICS.

Professor—M. Mallèvre, Agronomical Engineer.

Chief of Works—M. Baudoin, Agronomical Engineer, and Licenciate in Law.

III.—AGRICULTURAL MACHINERY AND RURAL CONSTRUCTION.

Professer—M. Max Ringelmann, Agronomical Engineer, Director of the Station for Machine-testing, Member of the National Society of Agriculture in France, Professor at the Higher National School of Colonial Agriculture.

Chief of Works—M. Vuaillet, Engineer of Arts and Manufactures.

Répétiteur—M. Coupan, Agronomical Engineer.

IV.—AGRICULTURAL TECHNOLOGY.

Professor—M. Luidet, Doctor of Science, Member of the National Society for Agriculture in France.

Répétiteur—M. Ernest Portier, Deputy-Chief of the Inspectorial Service for Classified Establishments, Licencié-ès-Sciences Physiques.

Préparateur—M. Louis Ammann, Agronomical Engineer.

V.—ECONOMICS OF FORESTRY.

Professor—M. Rivet, Conservator of Forests.

VI.—VITICULTURE.

Professor—M. Viala, Doctor of Science, Inspector-General of Viticulture, Member of the National Society of Agriculture of France.

Répétiteur—M. Pacottet, Agronomical Engineer.

VII.—COLONIAL CULTURE.

Professor—M. Dybowski, Inspector-General of Agriculture for the Colonies, Director of the Colonial Garden, Professor at the Higher National School of Colonial Agriculture.

Répétiteur—M. Fron, Doctor of Science.

VIII.—COMPARATIVE AGRICULTURE.

Maître de Conférences—Agronomical Engineer, Correspondent of the National Society of Agriculture.

IX.—ARBORICULTURE.

Maître de Conférences—M. Nanot, Agronomical Engineer, Director of the National School of Horticulture of Versailles.

X.—PISCICULTURE.

Maître de Conférences—M. Deloncle, Agronomical Engineer, Inspector-General of Pisciculture.

XI.—HIPPOLOGY.

Maître de Conférences—Mons. E. Lavalard, Member of the Higher Council of Agriculture and of the Consultative Committee as to Epizootics, Member of the National Society of Agriculture in France.

6. *Practical Teaching in Agronomy.*—The practical teaching is given mainly at the *Domaine d'étude* of the National Agronomic Institute at Noisy-le-Roi, the chief being M. Adrien Wallet, Agronomical Engineer. This domain for practical study is formed from a number of farms, etc., united. Its soils are of the most varied character, both as regards components and depth.

It contains 280 hectares, 72 ares, ·09 centiares—that is, not far short of 700 acres. It has extensive buildings and every convenience for systematic instruction. Chemical fertilisers are used in considerable quantity—about £440 worth in 1902. Among visits made may be mentioned those to factories for manufacture of sugar, starch, fertilisers, breweries, distilleries, creameries, etc.; factory for manufacture of margarine, etc.; visits to vineyards, to porcelain and glass factories, to factories where agricultural machinery is produced, to specially irrigated and drained areas, etc., etc. The whole has the object of widely informing the student and keeping him in close touch with the applications of agricultural science.

The various programmes will now be outlined in detail.

7. *Biology of Plants.*—The following has been translated by the Commissioner from the official publications, and reveals the thoroughness of the course:—

BIOLOGY OF PLANTS CULTIVATED IN FRANCE AND HER COLONIES.

PROGRAMME OF THE COURSE. (40 LECTURES.)

I.—APERÇU OF GENERAL BIOLOGY.

External morphology. Growth and decay, relative growth and decay, unequal capacity of growth; progressive differentiation, unequal capacity of differentiation, criterion of external perfection. Multiplication. Reproduction.

Internal morphology. Constitutive parts in the adult state. Mechanism of growth and decay. Mechanism of multiplication and reproduction.

External physiology. External conditions of growth. Action of the organism on its environment.

Internal physiology. Internal conditions of growth. Chemical phænomena; progressive synthesis of the elements; digestion; secretion; disassimilation. Mechanical phænomena: protection, support, locomotion.

Conclusion of this aperçu. Unity of object of Biology, unity of method, unity of classification, unity of nomenclature.

II.

II.—APERÇU OF GENERAL BOTANY.

Special and general characters of plants. Cellulose membrane: physical and chemical properties; growth in thickness; modifications by incrustation and transformation; partial or total division. Hydroleucites: their physical and chemical rôle. Amyloleucites: formation, growth, and properties of starch grains.

Chloroleucites: Chlorophyll and photochlorophyllian functions. Form, disposition, growth, and composition of chloroleucites. Physical and chemical properties of chlorophyll. Influence of radiation on the production of chlorophyll. Selective absorption of radiations by chlorophyll. Assimilation of carbon; synthesis of carbohydrates. Chlorovaporisation. Importance of these two phænomena. Progressive assimilation of elements beginning with the carbohydrates.

III.—SPECIAL BOTANY OF CULTIVATED PLANTS OR PLANTS OF SPECIAL INTEREST AS REGARDS CULTIVATION.[1]

Division of the Vegetable Kingdom into two sub-kingdoms: Arrhizophytes and Rhizophytes.
Arrhizophytes. Subdivision into two branches: Thallophytes and Muscineæ.
Thallophytes. Subdivision into two classes: Fungi and Algæ.
Fungi. General characters: Thalli and mode of life; formation of spores; formation of ova; development of the ovum. Division into four orders.

Myxomycetes: Trichiaceæ and Acrasaceæ.
Siphomycetes: Mucoraceæ, Saprolegniaceæ, Peronosporaceæ, Chytridiaceæ, Entomophthoraceæ, and Monoblepharidaceæ.
Basidiomycetes: Agaricaceæ, Lycopodaceæ, Tilletiaceæ, Tremellaceæ, Tylostomaceæ, Auriculariaceæ, Pucciniaceæ, Ustilagaceæ.
Ascomycetes: Perisporiaceæ, Spheriaceæ, Pezizaceæ, Laboulbeniaceæ.
Algæ. General characters: Thalli and mode of life; formation of the spores; formation of the ova; development of the ovum. Division into four orders.
Rhodophyceæ. Pheophyceæ. Chlorophyceæ. Cyanophyceæ. Nostocaceæ and Bacteriaceæ. Bacteriaceæ; morphology; physiology; Pathogenic bacteriaceæ; Fermentive bacteriaceæ.
Parasitism. Its various modes.
Symbiosis. Its various modes: Fungi with superior plants; Algæ with superior plants; Algæ with animals; Fungi with Algæ. Lichens. Rôle of lichens in nature: origin of terrestrial vegetation.
Muscineæ. Vegetative bodies: form, structure. Formation of spores. Formation of ova. Development of the ovum. Division into two classes: Hepaticeæ and mosses. Comparison of the Muscineæ with the Thallophytes. Résumé of the sub-kingdom of the Arrhizophytes.
Rhizophytes. Subdivision into two branches: Vascular cryptogamia or Exoprothalleæ, and Phanerogamia or Endoprothalleæ. Vascular cryptogamia. General characters. Vegetative bodies: form and structure of the root, stem, and leaf.
Formation of the ovum: isodiodeæ, heterodiodeæ. Development of the ovum. Division into three classes: Filicineæ, Equisetaceæ and Lycopodiaceæ.
Phanerogamia. General characters. Vegetative bodies. The root. External morphology and primary structure. External and internal physiology.
The stem. External morphology and primary structure. External and internal physiology.
The leaf. External morphology and primary structure. External and internal physiology.
The secondary regions: periderm, pachyderm. The secretions.
Formation of the ovum. Comparison with the vascular cryptogamia.
Development of the ovum in embryo, of the ovulum in the seed, of the pistil in fruit. Germination of the seed: morphology and physiology.
Special study. Division into two sub-branches: Astigmateæ and Stigmateæ.
Astigmateæ. Division into two classes: Natrices and Vectrices.
Natrices: Cycadaceæ, Zamiaceæ, Ginkgaceæ.
Vectrices: Abietaceæ. Baxaceæ and Cupressaceæ. Ephedraceæ, Welwitschiaceæ and Gnetaceæ. Résumé of the sub-branches of the Astigmateæ.
Stigmateæ. Division into three classes: Monocotyledons, Liorhizæ dicotyleæ, and Dicotyledons.
Monocotyledons: Lemnaceæ, Cyperaceæ, Araceæ, Palms, Joncaceæ, Commelinaceæ, Alismaceæ, Liliaceæ, Amaryllidaceæ, Dioscoreaceæ, Bromeliaceæ, Iridaceæ, Scitamineæ, Orchidaceæ. Résumé of the class of Monocotyledons.
Liorhizæ dicotyleæ: Gramineæ, Cabombaceæ, and Nympheacea.
Dicotyledons. Division into seven orders according to the ovule. Inovulated innucelleæ; Viscaceæ, Loranthaceæ, Dendrophthoaceæ. Inovulated nucelleæ; Anthobolaceæ, Arceuthobiaceæ, Nuytsiaceæ. Ovulated innucelleæ; Santalaceæ, Olacaceæ, Avicenniaceæ. Uni-tegmenated pernucelleæ; Myricaceæ, Juglandaceæ, Corylaceæ, Betulaceæ.
Bi-tegmenated pernucelleæ: Salicaceæ, Piperaceæ, Urticaceæ, Chenopodiaceæ, Castaneacea.
Platanaceæ, Vitaceæ, Rhamnaceæ, Violaceæ.
Polygonaceæ, Geraniaceæ, Caryophylleæ, Crassulaceæ.
Rutaceæ, Anacardiacea, Sapindaceæ, Leguminosæ. Rosaceæ, Malvaceæ, Tiliaceæ, Euphorbiaceæ.
Papaveraceæ, Renonculaceæ, Lauraceæ. Ribesaceæ, Onagraceæ, Myrtaceæ, Punicaceæ, Cactaceæ, Caricaceæ, Cucurbitaceæ. Unitegmenated transnucelleæ: Umbellifera, Umbelliferæ, Araliaceæ, Cornaceæ, Hydrangeaceæ.
Oleaceæ, Solanaceæ, Convolvulaceæ, Apocynaceæ, Asclepiadaceæ, Ilicaceæ.
Borragaceæ, Scofulariaceæ, Labieæ, Verbenaceæ, Plantagaceæ, Ericaceæ, Sapotaceæ.
Campanulaceæ, Rubiaceæ, Caprifoliaceæ, Valerianaceæ, Dipsacaceæ, Compositæ.
Bitegmenated transnucelleæ: Celastraceæ, Impatientaceæ, Oxalidaceæ, Linaceæ, Tropeolaceæ.
Cruciferæ, Resedaceæ, Theaceæ, Clusiaceæ, Hypericacea, Primulaceæ, Diospyraceæ.
Résumé of the class of Dicotyledons.
The Variation. Influence of the nature of the plant. Influence of the mode of formation of the ovum: pure race, mixed race: mongrel, hybridation. Influence of the weather: pure race, mongrel race, hybrid race. Influence of the environment. The theory of descent. Origin of the vegetation of the earth.

8. *Practical Botanical Work.* The practical exercises have relation to the Vegetable Biology, and consist of twenty manipulations of three hours each, and botanical excursions in the neighbourhood of Paris. Each *séance* of three hours relates to the work done in two lessons. The sixty hours laboratory work, corresponding to forty hours lectures, is divided into two series of ten *séances* (thirty hours) each, the first from October to January, the second from April to July.

The first embraces the study of the fungi, algæ, mosses, filices. The second embraces the study of the principal phanerogams.

During each *séance* of the second series, the fresh plants of Parisian flora are distributed to the pupils, who have to determine by making use of a specimen. The name of the plants examined must be written in the laboratory exercise book and are inspected at the end of the *séance*.

The

[1] No attempt has been made to translate the technical name in French into its equivalent in English. Thus "*Thallophytes*" perhaps should be rendered "Thallogens," "*Muscinées*" is rendered "Muscineæ." On the other hand, "Champignons" is rendered "Fungi."

The work in detail is as follows:—

PRACTICAL EXERCISES IN BOTANY.

First Series.

Use of the microscope. Management. Examination of the vegetable cell in an onion bulb. Membrane, protoplasm, stone, leucocytes. Cellulose thickening of the membrane in the stone of the date-tree. Action of zinc chloriodide. Local thickening of the membrane: cystolith of the Ficus elasticus.
Study of the Leucites. Hydroleucites: turgescence produced by the cellular liquid in the hairs of Tradescantia. Examination of the inulin in the tubercles of the Jerusalem-artichoke or of the Dahlia.
Amyloleucites: Study of the starch grains of the different cultivated plants. Action of iodized water.
Digestion of starch grains by amylolytic processes.
Chloroleucités: Examination of starch grains in a living leaf.
Solution of chlorophyll; its property.
Classification of Fungi. Myxomycetes. Rapid examination of a type *Syphomycetes*: Mucoraceæ vegetative and sporiferous preparation of the Mucor mouldiness, black Rhizopoda, etc. Methods of culture.
Peronosporaceæ. Vegetative and sporiferous preparation of the mildew of the vine, of lettuces, etc.
Reproductive apparatus and mode of formation of ova. Examination of mounted preparations.
Basidiomycetes. Vegetative and sporiferous preparation of a simple type; the stercoraceous Coprin, examination of the cap, of the mycelium, of the sclerotic.
Distinctive characteristics of the most common fungi from the living specimens (edible and poisonous fungi). Champignon de conche, blanc de champignon.
Ascomycetes: Perisporaceæ; examination of some common mouldiness: Penicillium, Aspergillum, Sterigmatocystum. Study of the Erycibeæ, of the truffle, etc. Sphœriaceæ. Pezizaceæ, study of a Peziza (Peziza of Fuckel). Sporifera preparation. Yeast (of beer).
Classification of algæ. Study of the vegetative and reproductive apparatus of some common sea-weeds. Special study of the Bacteriaceæ: Amylobacter bacilli, subtle baccilli. Methods of culture. Staining preparations: Examination of covering preparations of some pathogenic bacteriaceæ of animals.
Phænomena of Symbiosis. Micorrhizæ, Lichens.
Branch of the Muscineæ (Mosses). Rapid examination of some mosses and Hepaticæ: Polytrio (hair-moss), Sphagnum (bog- or peat-moss). Marchantia.
Branch of the Vascular Cryptogamous plants. Rapid examination of several types of Filicineæ, Equisetaceæ, Lycopodiaceæ.
Structure of the stem and root of the *Pteris aquilina.* Formation of ova. Prothalla.
Branches of the Phanerogamia. 1. *General study. Root.* Form. Ultimate structure (maize-root). Growth in length and in thickness of the root (Secondary formations in the bean root).
Stem. Form. Ultimate structure. Growth in length and in thickness (Stem of the vine).
Leaf. Form. Simple and compound leaves. Morphology and biology of the leaf.
Flower. Study of the constitutive parts.
Seed and germination. Seed of Ricinus Communis (Castor-oil plant), of Haricot, etc. Examination of different cases of germination.

Second Series.

2. *Special study of the principal phanerogamic families.*

Astigmateæ or Gymnospermæ. Cycadaceæ. Abietaceæ. Study of the male and female flower of the Fir-tree. Structure of the stem. Longitudinal and transverse section of the wood. General characteristics of the wood of Coniferæ (tracheidæ, areolar punctures, resiniferous canals). Distinctive characters of several Abietaceæ according to the specimens of living plants.
Stigmatæ or Angiospermæ. Cyperaceæ: male and female flowers of sedge (Laiche), characteristics of the stem, of the leaf, of the carex. Araceæ: the arum flower.
Palms: albumen of the cocoa-nut, of the Phœnician date. Joncaceæ.
Liliaceæ: characteristics of the bulb, structure of the stem, study of the flower.
Amaryllidaceæ: study of the agave (aloe) leaf, characters of the fibre. Bromeliaceæ. Iridaceæ. Orchidaceæ.
Graminaceæ: structure of the stem and the root; study of the spikelet of the grain, of oats, etc.; complete study of the seed of maize and of grain; distinctive characteristics of the various kinds of Graminaceæ; examination of fresh specimens and determination of flora (drawings of principal characters).
Corylaceæ. Betulaceæ. Urticaceæ. Cannabineæ, study of the stem of hemp, of branches, etc.
Chenopodiaceæ: morphological study of beet-root (stem, root, flower).
Castaneaceæ. Vitaceæ: stem and flower of vine.
Leguminosæ. Study of the root, nodosities of the roots and characteristics of the bacillus radiculosus, morphological study of the flower of leguminosæ.
Tiliaceæ. Malvaceæ: anatomical characters of the stem, examination of textile fibres. Euphorbiaceæ: examination of the flower of a Euphorbium, structure of the lacticiferous, characters of the fecula of Manioc. Curcurbitaceæ: morphological study of the stem, root, fruit, etc.
Umbelliferous plants. Solanaceæ: study of the flower, stem, and root of the tuberous night-shade (potato), examination of the fecula. Boraginaceæ. Scrophulariaceæ. Labieæ.
Compounds: comparative study of the flower of several types of Ligulifloræ, of Tubulifloræ. Linaceæ: flower and stem of flax, study of the seed. Cruciferæ: structure of the stem, the root; study of the flower in several types.

9. ***Botanical Excursions.***—Botanical excursions and herborisations are made in country of very varied types, the aim being to make the botanical experience as wide as possible. There are nine of these, at least. The variation of the flora, with the geological characteristics, is carefully noted.

10. *General Physiology.*—The course in general physiology is indicated in the following programme:—

General Physiology.

PROGRAMME OF THE COURSE. (30 LECTURES.)

I.

I. Biology, the study of life, as physics is the study of natural forces. Bonds which bind these forces with life. Claude Bernard and determinism. What must be understood by natural forces.
II. Influence of external agents on living beings. Latent life, oscillating life, homeotherms and poikilotherms. Constant life and its conditions.

II.

I. Differentiation of living beings. Dualism of Dumas. Monism of Cl. Bernard. Creation of living matter in plants. Its transformation by the herbivora, then by the carnivora. Ultimate destruction of the living molecule. Tyndall's theories.
II. Living matter. The idea of the ancients. Its general constitution, bioplasm. Researches of Berthelot, of Schutzenberger, of Pasteur, and of Pflüger. Ovogenesis.
III. Qualities of living matter. Irritability. Dubois-Raymond, Virchow, Pasteur, Bernard. The motility of bioplasm. Its sensibility. Anæsthetics.

III.

I. The internal means with animals. Its necessity for constant irritability of the bioplasm. The blood and the lymph. The Erythrocytes and the Leucocytes. The plasma. Fibrin. New ideas concerning the phagocytosis and the diapedesis. New conceptions of Metchnikoff and Pasteur concerning the cure of infectious diseases (anthrax, peripneumonia, typhoid, plague, etc.). Lymph.

IV.

IV.

I. Morphology of bioplasm: Hæckel and the monera; the cytodes. Gymnocytodes and lepocytodes among animals. The cell and the cellular theory. Protoplasmic and plastidular theories.
II. Grouping of the cellular elements. The tissues. Bichât and histology. Divisions of the tissues according to their rôle and their morphology.
III. Tissues of support. Simple and stratified epitheliums. The pavement epitheliums, their rôles, their diseases. (Itch and ringworm of animals.) Very short aperçu concerning the constitution of cancer. Vibratiles, their rôle. Very general ideas concerning catarrhal affections. The cylindrics, formation of the mucus.
IV. Glandular epitheliums. Ancient and existing conception of a gland. Present ideas concerning the holocrines and merocrines secretions. Action of the nervous system. Internal secretions.
V. Intercellular cement in its relations with the formation of the bone and the cartilage. Cartilaginous tissue. The "*chondroplastres*," their crusts. Osteogenesis. Idea of precocity. Union of epiphysis. Osteoplasts. Osseous matter. Influence of the régime among animals. Rachitis. Influence of the age. Fractures among aged draught animals. The periosteum. Experiments of Ollier.
VI. Connective tissue. The lophiodermis. Fatty tissue. Collecting of the fat. The adipose cell, fatty reserves. Fattening. Consumption of fat. State of the fatty reserves. Conditions of emaciations. Clasmatocytes and mastzellen.
VII. Elastic tissue, its utility. The ligaments (application). The hide, and the tanning of connective tissue. The tendons of the muscles.
VIII. The nerves. The nerve fibres and cells, histological study. The work of Ranvier, of Gerlach, of Golgi. Present theories of Ramon y Cajal. Fibres of Remack.
IX. Physiology of the nerve. Prejudicial study of the application of the graphic method to general biology, and to zootechnics. The nervous functions. Nutrition of the nerves. Phosphatic alimentation. Chemistry of the nerves. Centripetal and centrifugal conduction. The reflex and the diastaltic arc. The nervous influx and its vitality. The excitants of nervous tissue. The centres, the ganglions. Nutrition and the nerves. Tropical and vaso-motor nerves.
X. Muscle. General morphology of the muscular system. Flexors and extensors, the joints. Striated muscle and its constitution, its rôle. Smooth muscle. Physiology of muscular contraction, elasticity of the muscle, its tonicity. Muscular sensibility. Contractility. Graphic researches of Marey and Vierordt. Detailed theory of contraction. Muscular poisons. Muscular toxines and jaded animals.

V.

I. Cellular reproduction and the creation of bioplasm. Theories of generation. Spontaneous generation. Pasteur and Pouchet. Panspermia. Generation and scissiparity. Conjugation. Sexual reproduction. Male organ and spermatogenesis. Female organ and ovogenesis. Detailed phænomena of fecundation. Amphiaster. Theory of monsters. Segmentation. Morula, Blastula, Gastrula. Heredity.

VI.

I. Production of living matter. General idea of alimentation. Perfect aliment. Milk and the meroblastic ovum. The breast. Chemistry of the milk and the egg. The "lab" ferment and rennet.
II. Alimentary substances compared with perfect aliment. Composition of the living allowance. Ration of the workman, ration of the horse, of the working ox, to fatten. General ideas concerning the substitutions.
III. Elaboration of the aliment. Digestibility of the various aliments. Fixation of the coefficient of digestibility The digestive juices. Action of microbes. Fabrication oftoxines. Auto-infection. Buccal digestion. Stomachic digestion. Study of gastric ferment and acid. The law of partition (Berthelot, Richet). The Pancreas and the intestinal zymases. Gastric and intestinal peptones. The inversion of sugars.
IV. The liver. Its structure. The hepatic lobule. The hepatic circulation. Conception of the ancients concerning the rôle of the liver. Dualism of Charles Robin. The vile-gland. Monism. Chemical composition of the bile. Its rôle as a digestive liquid.
V. The absorbent apparatus. Epithelium with pseudopodia. Absorption of liquids, absorption of fats. Application of the laws of dialysis. Penetration into the blood. Dissemination in the cellular colony.

VII.

I. Fixation of the nutritive elements or intimate nutrition. The carbohydrates transformed into sugar. Arrival at the liver. Transformation into glycogenous matter. Hepatic and glycolytic ferment. Definitive disappearance of sugar. Claude Bernard and the glycogenous function of liver.
II. What becomes of the fats. Transformation of sugar into fats (Hanriot). Transformation of the albuminoids into fats and sugars. The functions of the pancreas. Formation of the calcareous reserves (Works of Dastre). Fixation of the quarternary matters by "déshydratation." Definitive constitution of bioplasmic matter.

VIII.

I. Vital destruction of the bioplasmic molecule. Action of oxygen. Oxidation of the tissues. Respiration according to the ancient writers. Lavoisier. The respiratory apparatus. Mechanism of respiration.
II. Hæmatosis. The gases of the blood. Arterial blood. Venous blood. Combustion within the cells and in the blood. Gaseous exchanges. Their mixtures. Products of combustion.—CO_2, H_2O, NH_2, $CO\ NH_2$. Definitive results of the destruction of the bioplasm. Regnault and Reiset. Pettenkofer and Voit. The bile, excretion of combustion products. Urea and uric acids. The kidneys.

IX.

I. Production of heat. Experiments of Lavoisier, of Dulong. Present ideas (Berthelot). Calorific equivalences of sugar, of starch, of fats, and of albuminoids. Action of external heat. Calorific topography of animals. Cooling. Action of the nervous system.
II. Transformation of heat into energy. The working animal. Equivalence with the rations. Work produced by the destruction of sugar, of fat, and of albumen. Works of Chauveau. Idea of the living motor. The definitive aim of all vital activity is the destruction of the molecule of bioplasm and the correlative production of motion and of work. (Experiments of Wislicenus.)

Whence result:
The vital equilibrium. Its modifications. Health. Sickness. Exaggerated denutrition and degeneration.

X.

I. Death, Partial, gangrenes and necroses. Total and definitive. Agony. Absolute death. Aerobic and anaerobic putrefactions. Formation of ptomaines. Restitution of N, of H, of C, and of O to the atmosphere, of the mineral products to the soil. The circulation of matter. Return to the first chapter of the course and *rapprochement* with the study of the formation of bioplasm.

The comprehensiveness of the course is obvious. It should be mentioned that the instructors are not only in touch with men engaged in the most recent researches in this field, and with the remarkable results obtained, they are also themselves investigators and discoverers.

11. *Zoology, and its Application to Agriculture.*—There are thirty lectures in this course, as follows:—

PROGRAMME OF THE COURSE IN ZOOLOGY. (30 LECTURES.)

GENERALITIES.

Relations between animals and plants in the general economy of nature. Relations between man and animals. Relations of animals to one another; struggle for existence; predation; parasitism; commensality; mutuality; animal societies.

Division of the Animal Kingdom into branches.

THE PROTOZOA.

General characters; classification.

Rhizopoda: Amœba.

Sporozoa:

Coccidiæ. Coccidia of the rabbit, taken as type, hepatic coccicíosis of the rabbit; coccidia of the hen.

Myxosporidia. Structure and development; disease of the blue-bottle (Myxobolus); disease of the crayfish (Thelohania); epidemic among silk-worms (Nosema bombycis).

Sarcosporidiæ. Sarcocystis.

Hemosporidiæ. Plasmodium malariæ, malaria; Pyrosis, Texas fever of the bovidæ, etc.

Infusoria: Flagella, Noxious flagella in fish; pathogenic flagella, Trypanosomæ of the "surra," of the "nagana," of the "dourine."

Cilia. Noxious cilia in fish, in the paunch of the ruminants.

VERMES.

General characters. Classification.

Cestoda. General organisation, metamorphosis and migration. Monographic study of the Tænia serrata, as a common type.

Tetracestoda. Tetracestoda having a vertebrate for intermediary host. Diseases in the ox, pig, the staggers. Echinococcus. Tetracestoda having an invertebrate for intermediate host. Tænia of birds. Tetracestoda, having no known intermediary host. Tænia of the herbivora.

Dicestoda. Bothriocephala, "ligules," prophylaxis against ligules in pools.

Trematoda. General characteristics, monographic study of the great "Douve" (fluke) taken as type.

Distomata of the sheep, prophylaxis. Other species of Trematoda of interest in applied zoology.

Nematoidea. Parasitic nematodes. Ascaris taken as type. Oxyures. Strongyles. Strongylosis of the stomach. Verminous bronchitis. Syngamy of the trachea. Sclerostomata. Anchylostomata. Treatment, and prophylaxis of diseases produced by these animals. Trichinæ, characters, evolution, ætiology, trichinosis. Prophylaxis. Official staff for inspection of meats. Filaria.

Nematodes injurious to plants. General character of the Anguillulides. Tylenchus vastrix, and diseases which it produces in various kinds of culture.

Tylenchus tritici and blight of corn: preventive treatment. Doryläimus. Heterodeva Schachti (Anguillule of the beet-root) and heterodera radicicola. Method of snare-plants.

Acanthocephala. Echinorhynchus.

Annelida. General characteristics. The medicinal leech; the horse-leech. Branchiobdella. The earth-worm. Rôle of the earth-worm from the point of view of its utility in the economy of Nature; and from the point of view of its injuriousness. Propagation of morbid germs by means of earth-worms.

Enchytreida.

ARTHROPODA.

Principal characteristics of their organisation.

Crustacea. General characteristics.

The crayfish. Organisation. Biology and reproduction. Diseases and enemies. Fishing for and commerce in crayfish. Astaciculture repopulation of a watercourse. Raising in pools and artificially.

Classification of the crustacea and review of the principal types which have interest from a commercial point of view. The homard (lobster) and homariculture. Establishment of Norway, Canada, Newfoundland. The various lobsters and crabs.

Inferior crustacea.

Arachnida. Characteristics and principal features of their organisation. One of the Aranoidæ taken as type. Classification.

Linguatulida. Acarians. Acarians injurious to animals. Demodex and follicular galls. Psoric sarcoptida and various galls produced by them on man and the domestic animals. Trombidium and wheal-worms. Ixoda Argas. Dermanysses. Acarians injurious to plants. Phytopta and phytoptocecidia, erinosis of the vine.

Tetranycha. Grey and red disease of the vine

Acarians which attack alimentary substances.

Tyrozlyphs, Glyciphags, Aleurobia.

Araneidæ. Silk of the Araneidæ. Experiments in connection with its industrial utilisation.

Scorpioides.

Myriapoda. General characteristics, principle type injurious in cultivation. Iula, Blaneiula, Polydesma. Venemous Myriapoda. Scolopendra.

Insecta. General characteristics, external morphology, organisation, reproduction, metamorphoses.

Division of class into orders.

Orthoptera. Characters, classification. Orthoptera injurious to the interior of dwellings, to the plants of the kitchen garden, to all cultivation.

The Acridians. Development, biology, geographical distribution, progress of invasions. Organisation against them. Methods of prevention and destruction. Apparatus.

Neuroptera. Characters, classification, review of the principal types, insisting on the injurious species (termites) and useful species (Hemeroba, etc.)

Thysanoptera.

Coleoptera. General characters, classification, characteristics and biology of the principal families of the larvæ corresponding to them. Those injurious to cereals and seed, to forage plants, to the kitchen garden, to fruit-trees, to the vine, to forest-trees.

The principal injurious coleoptera are successively passed in review in the order above indicated, insisting principally on their biology, and upon the method of destruction or prevention applicable in each case.

The *Hemiptera*, *Lepidoptera*, *Diptera*, *Hymenoptera*, are similarly treated.

The following subjects are equally fully discussed, viz.:—

(1) The technical details of Agricultural Entomology.
(2) The utilisation of vegetable or animal auxiliaries to destroy or prevent the injury of injurious insects.
(3) The *insecta* injurious to both man and animals—*e.g.* the Anopheles (mosquito), and the diseases it can communicate.
(4) Insects directly useful. The bee and apiculture.
(5) The silkworm and sericulture.
(6) *Mollusca.* The Lamellibranchia, Gasteropoda, Cephalopoda. The oyster and oyster-culture, its enemies and diseases.
(7) *Vertebrates. Fish* and pisciculture, Batrachians; Reptiles; Birds. Importance of protection of certain birds. The mammifera and their relationship to economic zoology.

12.

12. *Programme of Exercises in Agricultural Zoology.*—This covers the range already indicated in the preceding section (Sec. 11), and a certain amount of dissection is done. The course is very thorough and confirms the lecture work.

13. *Geology applied to Agriculture.*—The lectures cover the following ground, viz.:—

GEOLOGY APPLIED TO AGRICULTURE.—PROGRAMME OF THE COURSE. (25 LECTURES.)

INTRODUCTION.

Definition of geology. Special aim of the teaching of geology in the "*Institut Agronomique.*" Utility of geology from an agricultural point of view.

I.—STUDY OF ACTUAL PHÆNOMENA.

Form and density of the earth. Increase of the temperature with the depth. Primitive fluidity of the earth. Laplace's hypothesis.
Temperature of the surface of the earth, atmospheric and marine currents.
Distribution of land and sea. Form of the continents; distribution of reliefs; form of oceans; distribution of the depths. Mountains.

A.—Action of the atmosphere.

Disintegration of rocks, removal of the material; fertilising sand and dust; dunes; causes of their extension; deforestation. Fixation and utilisation of sand-dunes. The dunes from an agricultural point of view.

B.—Action of water.

Water considered as a destructive agent. Action on the coasts. Formation of pebbles, sand, and mud. Action of water in circulation in the atmosphere. Rains; infiltration; water-bearing sheets and artesian sources. Trickling and erosion; erosion of valleys; régime of torrents and deforestation; agricultural value of ejected cones of torrential origin.
Hydrographic network of pervious and impervious ground. Glaciers.
The study of water as an agent of construction. Running water; alluvion. Fluviatile alluvions from an agricultural point of view.
The course of water in estuaries and deltas. The Camargue.
Destruction of continents by erosion and solution.

C.—Action of water and organisms.

Marine deposits. Littoral apparatus, filling up of lagoons, genesis of polders (land reclaimed by high embankments). Sediment of sea-shores. Influence of deposits of a calcareous character on the fertility of the littoral zone in Britany, Vendée and Cotentin.
Terrigenous sediments; pelagian deposits. Construction by coral insects.
Destiny of dissolved matters deposited into the sea by fresh water; actual formation of calcium-phosphate. Deposits of gypsum and salt due to the evaporation of sea-water in the closed basins or lagoons.
Continental deposits. Lacustrian sediments utilissd in agriculture. Turf. Influence of cultivation on turfs. Turf from an agricultural point of view. "Terre noire" of Russia.
Guano; phosphatic rocks formed by the influence of guano.

D.—Volcanic Phænomena.

Volcanos; lava and gas. Causes of the ascension of lava. Volcanoes of Europe; sub-marine volcanoes. Origin of volcanic mountains. Distribution of volcanoes and their relation to the lines of dislocation. Extinct volcanoes. Actual volcanic products considered from an agricultural point of view.
Phænomena connected with volcanic activity. Solfataras; geysers; suffioni, oil wells and gasoous emanations. Thermal sources.
Earthquakes. Slow oscillations of the terrestrial surface.

II.—NOTIONS OF PETROGRAPHY.

Composition of the earth's crust; eruptive rocks; crystalline and sedimentary rocks.

A.—Eruptive rocks.

Essential minerals and their characters; importance of their chemical composition from the point of view of agriculture.
Chemical composition of eruptive rocks. Structure; granitic and porphyritic rocks.
Modes of occurrence: massive, flows, lodes.
Lithological definition of the principal rocks.
Metamorphic action of eruptive rocks on sedimentary deposits.
Decomposition of eruptive rocks; nature of the phænomena; physical and chemical properties of the soils derived from them. Necessary amelioration for each category. Water-bearing character of these soils and particularly of the granitic regions.
Useful matters furnished by eruptive rocks.

B.—Crystalline rocks.

Lithological definition; soils which result from their decomposition.

C.—Sedimentary rocks.

Nomenclature. Definition and composition of the principal terms Transformation of sedimentary rocks under the influence of atmospheric agents; phænomena of hydration, solution and oxidation which determine the decomposition of these rocks. Consequence from an agricultural point of view.

III.—STRATIFICATION.

Principal of the classification of stratified rocks. Succession of geologic periods and stages.
Principal accidents of stratified rocks; foldings, faults, gaps. Concordance, discordance, and overlap.

Crystalline or metamorphic rocks.

Gneiss, mica-schists, etc. Hypothesis concerning the mode of formation of gneiss. French regions where the crystalline rocks are found. General characters of the soils which result from their decomposition.

PRIMARY PERIOD.

Generalities; fauna, flora, divisions.

Pre-Cambrian.

Soils of Pre-Cambrian rocks. Pre-cambrian chain.

Silurian.

Silurian.

Silurian of Brittany and Normandy; its connection with those of Wales. Silurian of the Ardennes, the Black Mountain and the Pyrenees. Classic Silurian of Bohemia. Extension of the Silurian sea. Eruptions; Silurian chain.
Useful materials furnished by the Silurian rocks.
Agricultural value of the soils formed by the Silurian rocks in France; nature of the necessary amendments.

Devonian rocks.

Devonian sea. Devonian strata of the Ardennes; Boulonnais, Brittany, Black Mountain, Pyrenees. Explanation of the very variable importance of the limestone deposits in the Devonian strata of these regions. Bohemia and England. Devonian eruptions. Useful materials. Phosphates of Nassau.
Devonian strata from an agricultural point of view. Amelioration possible by using calcareous Devonian strata.

Carboniferous strata.

Great development of the Vegetable Kingdom. Nature of the sediments. Carboniferous seas and lagoons.
Dinantian period. Carboniferous limestone and anthracite coal. (1) Carboniferous limestone: Ardennes and Boulonnais; great development of calcareous strata exploited for limestone, etc. (2) Brittany: importance of layers of anthracite for the fabrication of limes for amelioration of soils. Vosges, Central Plateau, and the Pyrenees. Black phosphates of the Pyrenees.
Westphalian period. Coal-beds of Belgium and the North.
Stephanian period. Coal-beds of the centre of France. Basin of Commentry selected as an example. Stephanian eruptions. Origin of coal. Characters of the soils formed by the carboniferæ of France. A glance at the carboniferæ of Europe. Rising of the Hercynian chain.

Permian.

The Permian sea. Permian strata in France: Vosges, Autonois, etc. Useful materials furnished by the Permian rocks: Bituminous schists, bogheads, etc. Composition of soils formed by the French Permian rocks.
Permian strata in foreign lands: England, Germany; layers of potash salts of the Permian of Stassfurth; Russia.
Metamorphic Permian strata of the Alps. Permian eruptions.

SECONDARY PERIOD.

Generalities. Fauna. Flora. Divisions.

Triassic.

Distribution of land and seas. Triassic strata of Lorraine; gypsum and rock-salt of the Keuper; characters of the three divisions of the Triassic of Lorraine from an agricultural point of view.
Continental surface and the lagoons of the Triassic in the north of Europe. Layers of gypsum and rock-salt in relation to this surface.
Extension of the Triassic in France. Marine Triassic of the Alps: Triassic eruptions.

Jurassic.

General characters. Different types of sediments; abundance of limestone; phosphates of lime and iron-ores.
Lias. Description of the Lias of the basin of Paris. Useful materials: heavy limestone; hydraulic cement and lime. Phosphatic nodules at several levels: iron-ores of Lorraine (scoria from dephosphoration). Composition of marls and limestones of the Lias.
Lias opposite the gulf of Luxemburg, in the Ardennes (pyritic ash), in Normandy, etc. Properties from an agricultural point of view.
Middle Jurassic. Composition in the basin of Paris; calcareous earth and calcareous marl; phosphates of lime of the "Bajocien" of Normandy. Soils of the Middle Jurassic, partly marly or exclusively calcareous; various examples.
Middle Jurassic of the Jura, of the Rhône basin, and of the central Plateau. Lignites of the Caucasus.
A glance at the Middle Jurassic of England which has furnished the type of rock.
Higher Jurassic. General characters of the formation in the Paris basin. Alternation of clayey and limestone deposits. Emersion of the basin at the end of the period.
Very varied nature of the cultivations in harmony with the changes of lithological composition of the higher Jurassic.
Callovian.
Oxonian. Characters of the argillaceous zone (Normandy, Boulonnais, Ardennes, Lorraine); water-bearing strata. Earths used for bricks, tiles, etc. Iron ores.
Rauracian. Essentially calcareous in the Paris basin; characters of the Rauracian soils.
Kimmeridian. Lower Normandy, Bray region, etc., earths more or less argillaceous: water-bearing strata.
Portlandian. Bray, Lower Boulonnais, Charentes, etc. Characters of the soils.
The Higher Jurassic in the Jura. Change of composition in the stages from the north to the south. Geological characters of different agricultural regions.
The Higher Jurassic in the Alps and the south of France; tithonic character; insensible passage from the Jurassic to the Cretacea. Lithological characters of the various stages and their significance for agriculture.
A general glance at the European Jurassic; general geography of the period.

Cretaceous.

General characters. Particular nature of the sediments. Important layers of calcium phosphate.
Infracretaceous. Site of the sea as explanatory of the special nature of the infracretaceous sediments of the Paris basin. Useful materials furnished by the Neocomian and the "Aptien." Importance of the "Albien" from an hydrological and agricultural point of view; numerous layers of calcium phosphate in nodules. Lithological transformation in the strata to the south from the Paris basin.
Infracretaceous in Belgium and England.
Marine infracretaceous from Jura; importance of the "Hauterivien" from an agricultural point of view. Iron ores.
Phosphates from the Gault. Infracretaceous in the south of France.
Higher Cretaceous strata. Inroads of the sea. Paris basin. "*Cénomanien.*" Variations of composition around the basin and varieties of cultures which result therefrom. Phosphates of Pernes.
"*Turonien.*" Chalk more or less marly. Phosphate in grains from the Cambresis, in nodules from the vicinity of Lille.
"*Sénonien.*" Soils formed from the "Senonian" chalk. Formation of argillaceous soils by the decomposition of white chalk. Clay with flints. Layers of calcium phosphate from the Somme, from the Pas-de-Calais, and from the Aisne. Frequency of magnesian chalks. Utilisation of chalk for the marling of tertiary soils and quarternary clays.
"*Danien.*"
Upper cretaceous strata in the south-west of the Paris basin. Tufa. Sénonien covered with clay and decalcified flints.
Upper cretaceous strata of Belgium. Layers of calcium phosphate.
Upper cretaceous strata of "Aquitaine." Nature of soils formed by the "Turonien" and the "Senonien."
The upper Cretaceous strata in Provence. Lignites of Fuveau. A glance at the general geography of the cretaceous epoch.

TERTIARY PERIOD.

Generalities. Divisions.

Eocene and Oligocene.

Description of the eocene and oligocene strata of the basin of Paris. Oscillations of the sea. Division of the Tertiary strata of the Paris basin into natural regions (Soissonnais, Valois, Ile de France, Brie, Beauce, etc.), having each a special geological constitution and particular properties from an agricultural point of view. Useful materials: ashes for agriculture, gypsum. Water-bearing strata.

Eocen

Eocene of the North, of Normandy and Brittany. Aquitaine; properties of the principal levels from an agricultural point of view. Eocene of the Pyrenees and Alps; Flysch.
Oligocene of Aquitane, of the basin of the Rhône and Alps. Oligocene deposits of the Central Plateau; reasons of the exceptional fertility of the Limagne. Phosphites of Quercy. A glance at the Eocene and Oligocene of Europe. Phosphates of Algeria and Tunis.

Miocene.

Definitive formation of the Alpine chain. Distribution of the Miocene in France. Basin of the Loire (Sologne). Brittany; fragments of "faluns," used for amelioration. Basins of the Garonne and the Rhone. Miocene of Belgium. The "mer mollasique" in Switzerland and in Austria.

Pliocene.

Distribution in France. Basin of the Rhône; Crau. Bresse; Roussillon. Normandy; phosphates of Gourbesville. Pliocene of the North of France, England, and Belgium.
Volcanoes of Auvergne; soils formed by their products.

QUATERNARY PERIOD.

Fauna: climates and their variations. Appearance of man.
Flints. Marine deposits. Glacial phænomena; possible causes of glacial extension. Deposits of glacial origin.
Quaternary alluvions. Clay, its origin. Composition of the different zones of clay; their properties from an agricultural point of view.
Rocks of modern formation; maritime plain of Flanders. Polders of Mount Saint Michael. Marshes on the shores of the Atlantic, Camargue, etc.
Calcium phosphate and its various states: apatite, phosphorite. Sedimentary phosphates: coproliths, nodules and phosphates in grains. A glance in general at the layers of calcium phosphate of France, Algeria, and Tunis.
Origin of sedimentary calcium phosphates. Guanos and nitrates.
Vegetable earth. Soil, sub-soil. Origin of culture soil. Modification of superficial rocks under the influence of man, of atmospheric agents and organisms.
Methods of study of soils. Insufficiency of chemical analysis. Calcimetric charts. Insufficiency of geological charts from an agricultural point of view. Agronomical charts based on geology and chemistry; method to follow for the preparation of these charts. Utility and future of such charts.

14. *Geological Excursions.*—A variable number of geological excursions are made during the course, under the direction of the Professor of Geology. They allow of the study of the Cretaceous, the Eocene, and the Oligocene, as exhibited in the Paris basin. The professor expounds on the spot the stratigraphical, petrographical, and palæontological characteristics of the formations observed and their significance for agriculture.

He makes a rational diagnosis of all the sedimentary rocks met with, and points out the transformations to which they are subject, under the influence of organic, physical, and chemical agents,

Several of the excursions afford excellent opportunities for the reading of geologic charts. There is a great (optional) excursion in July.

15. *Practical Exercises in Petrography.*—The practical exercises have for their object the attentive study of rocks and fossils The methodical examination of specimens is guided by the Répétiteur who directs each exercise. These cover the following range:—

Exercise (1) Constituent elements of eruptive rocks. (2) Granitoid eruptive rocks. (3) Porphyritic eruptive rocks. (4 and 5) Sedimentary works. (6) Characteristic fossils of the primary era. (7) Of the secondary era. (8) Of the tertiary era.

In determining a mineral, or rock, or fossil, he must outline its history. He must recognise and name the elements in granite, give its name, the chemical composition of its elements, what is known of its origin, and state what it will become under the action of destructive agents, etc.

16. *Vegetable Pathology.*—The course involves twenty lectures, and micrographic exercises. The lectures cover the following ground, viz.:—

VEGETABLE PATHOLOGY.—PROGRAMME OF THE COURSE.—(20 LECTURES.)

Generalities of vegetable pathology. Comparison between vegetable and animal diseases.
Relations between vegetable pathology and botany. Method in vegetable pathology.
Two great divisions: non-parasitical diseases, due to external agents. Parasitical diseases due to living organisms.
Teratology, or study of monstrosities. Principal cases: Fasciation, albinism, chloranthus (foliation, virescence), viviparity, phyllomania, peloria.

NON-PARASITICAL DISEASES.

Wounds and their modes of cicatrisation.
Formation of the cicatrix of the cork-tree in the living cellulous tissues.
Rudimentary cicatrisation of wood by the formation of gum from the wound, or by the effusion of resin (coniferæ).
Cicatrisation of wounds from cutting: Simple swelling (cellular); complex swelling.
Cicatrisation of ligneous wounds. Ligneous swellings; rational pruning.
Mode of formation of gum. Two principal types. Amygdaleæ.
Action of cold on plants; action of frost on plants. The living cell and the nucleus. Crack caused by frost.
Action of heat; asphyxia. Folletage. Action of humidity.
Etiolation. Asphyxia of roots. Action of poisons on plants: Mercury. Sulphurous acid. Lighting gas.
Chlorosis: Action of limestone, of humidity.
Influence of the colour of the soil.

PARASITICAL DISEASES.

Different modes of life of plants: Humicoles; Saprophytes; Parasites.
The parasitism and symbiosis. Various modes of parasitism: necessary parasites. Parasites which wound. Optional or accidental parasites.
Influence of external actions (wounds, cold, humidity) upon parasitism.
Classification of parasites: vegetable, animal.

PARASITICAL DISEASES OF VEGETABLE ORIGIN.

Classification of vegetable parasites: Bacteria, Algæ, Fungi, Phanerogamia.
Bacterial diseases: generalities concerning bacteria.
Their provisional classification.
Bacteriosis of the olive-tree (Tumors or tuberculosis of olive-tree).
Bacteriosis of the Aleppo pine-tree (Tumors of the Aleppo pine-tree).
Gummous bacilli of the vine-tree: "gélivure," apoplexy.

Disease

Disease "Coup de pouce" of the grape. Disease of the branches of the mulberry-tree. Bacillus diseases of the potato: "Gale."
Bacillus amylobacter and its analogues.
Caulivorus bacillus (Butrefaciens liquefaciens) producing gangrene of the stem. Bacillus solanincola. Jaundice of the beet-root. Fat of kidney-beans. Rose wheat.
Mucous flowings from trees.
Disease produced by one of the algæ. The cephaleuros virescens parasite on the tea-tree, coffee-tree, etc.
Diseases produced by fungi. Classification of the fungi. *Myxomycetæ. Fuligo septica. Plasmodiophora Brassicæ* (Hernia of the cabbage).
Oomycetæ. Chytridineæ. *Olpidium Brassicæ* (upon the cabbage). *Olpidium trifolii* (upon the trefoil).
Cladochytrium leproides (Leprosy of beet-root).
Cladochytrium graminis (upon the gramineæ of meadows).
Asterocystis radicis (Brûlure of the flax).
Peronosporeæ. Mildew of the vine. *Peronospora viticola.* Cupreous powders.
Peronospora nivea (on the Umbelliferæ). *Peronospora effusa* (upon spinach). *Peronospora Schachtii* (on the beet-root). *Peronospora Schleideni* (on the onion). *Peronospora gangliformis* (on the lettuce), etc.
Phytophthora omnivora (on various plants).
Phytophthora infestans (disease of the potato).
Cystopus candidus (white rust of Cruciferæ).
Cystopus cubitus (white rust).
Pythium of Baryanum (on various plants).
Basidiomycetæ. General classification: Homobasidiæ, Heterobasidiæ.
Homobasidiæ.
Hymenomycetæ. Generalities. Classification.
Agaricineæ: *Agaricus melleus, Pholiota destruens.*
Polyporeæ. *Polyporus annosus. Polyporus Pini. Polypporus hispidus. Polyporus sulphureus. Polyporus Hartigii. Polyporus ignarius. Polyporus fulvus. Polyporus fomentarius.* General lesions of the polyporæ. Treatment.
Merulius lacrymans (wood fungi).
Hydneæ. *Hydnum diversidens,* on the oak, etc.
Typhula variabilis on beet-root.
Thelephoreæ. *Stereum frustulosum* on the oak. *Stereum hirsutum.*
Hypochnus Solani on the potato.
Exobasidieæ. *Exobasidium Vitis.*
Heterobasidiæ. The "baside" of *Auricularia,* and the "baside" (promycelium) of the Uredineæ and the Ustilagineæ. The "probaside" (teleutospore).
Uredineæ: General characters of the family. The diseases produced: mildew, blight, etc.
Puccinia. Rusts of cereals: *Puccinia graminis* (on wheat, oats, etc.). *Puccinia rubigo-vera* (on various gramineæ). *Puccinia coronata* (on oats, etc.).
Theory of Eriksson. The mycoplasma.
Various rusts due to *Puccinia*: Rusts of garlic, asparagus, of the Compositæ, Umbelliferæ, plum-tree, maize, sorghum, Malvaceæ, and of the carnation.
Uromycæ. Rust of peas, of the carrot, bean, and clover.
Hemileia vastatrix. Rust of the coffee-tree.
Gymnosporangium. Rust of the pear-tree (form Rœstelia) and of the juniper-tree (Juniperus Sabina).
Phragmidium. Blight of roses and briars. (Phragmidium Rubi-Idœi. Phragmidium subcorticium.) Blights of the coniferæ. Rust of the pine-tree. Blight of the Aspen (*Cæoma pinitorquum. Melampsora Tremulæ*).
Vesiculate blight of the bark of the wild pine-tree (*Peridermium Cornui. Cronartium asclepiadeum*).
Vesicular rust of the barks of the wild pine-tree (*Peridermium oblongisporium. Coleosporium Senecionis*).
Vesicular rust of the needles of the pectinal fir-tree (*Peridermium columnare. Calyptospora Gœppertiana*).
Rust of the needles and "Balais de Sorcière" of the pectinal fir-tree (*Peridermium elatinum. Melampsorella Cerastii*).
Vesicular rust of the needles of the Epicea. Rust of the Rhododendron (*Peridermium abietinum. Chrysomyxa Rhododendri*).
Orange-coloured rust of the needles of Epicea. (*Chrysomyxa Abietis.*)
Ustilagineæ (Black rusts). General characters of the family.
Ustilago: Ustilago Maydis (Maize). *Ustilago Tritici* (Wheat). *Ustilago Avenæ* (Oats). *Ustilago Hordei* (Barley). *Ustilago Sorghum* (Sorghum). *Ustilago Panici-miliacei* (Millet).
Tilletia. Tilletia caries and *Tilletia levis* (Caries of wheat).
Urocystis: Urocystis occulta (Rust of rye). *Urocystis Cepulæ* (Rust of the onion).
Graphiola Phœnicis (Disease of the date-tree).
Ascomycetæ. General characters of the family. Classification of the Ascomycetæ. Modes of sexual reproduction.
Exoasceæ (Rust and "Balais de Sorcière").
Exoascus. *Exoascus deformans* (Brown rust of the peach-tree). *Exoascus Cerasi* (Rust of the cherry). *Exoascus Pruni* (of the plum).
Taphrina: Taphrina bullata (Rust of the pear-tree).
Taphrina aurea (Rust of the pyramidal poplar).
Discomycetæ:
Rhizina undulata (Disease of the root of pines).
Rœsleria hypogea, on roots of the vine and of various trees.
Dasyscypha Wilkommii (Canker of the larch).
Peziza on Sclerosis. *Sclerotinia Libertiana* on various plants. *Sclerotinia Fuckeliana* and *Botrytis Cinerea* on various plants (Web, grey dust of the vine, noble rust of grapes). *Sclerotinia Trifoliorum,* on clover, sainfoin, etc. *Stromalinia Cydoniæ,* on Coignassier. *Stromatinia temulenta* (Disease of the rye). *Monilia fructigena* (Rust of apples, pears, peaches, plums).
Phacidieæ: *Pseudopeziza Trifolii* on clover and lucerne.
Rhytisma acerinum and *Rhytisma punctatum* on maples.
Hysteriaceæ: *Lophodermium Pinastri* ("Rouge" of the pine-tree). *Lophodermium macrosporum* on Epicea. *Hypoderma nervisequum* on pectinal fir-tree.
Pyrenomycetæ.
Spheriaceæ.
Guignardia Bidwellii—Phoma uvicola (Black-rot of the vine).
Coniothyrium Diplodiella (White-rot of the vine).
Pourridiæ.
Rosellinia quercina (Pourridiæ of the oak). *Rosellinia aquila* (Rot of the mulberry-tree). *Rosellinia necatrix* (Rot of the vine, mulberry-tree, fruit-trees, etc. *Rhizoctonia violacea,* on lucerne, saffron, potato, beet-root, etc *Rhizoctonia Solani* on potato.
Didymosphaeria populina on the pyramidal poplar.
Sphærella Fragariæ (Decay on strawberry leaves). *Sphærella Mori* ("Nuile" of the mulberry). *Sphærella tabifica* (Disease of the heart of the beet-root).
Gibellina cerealis on the leaves of cereals. *Dilophia graminis* (Anthracnosis of the ear of corn). Stamping out of cereals produced by *Ophiobolus graminis* and the *Leptosphæria herpotrichoides.*
Sphærella Tulasnei: Cladosporium herbarum (Smut of cereals).
Pleospora albicans on chicory. *Pleospora herbarum* on common garlic.
Alternaria Solani on potato leaves. *Alternaria tenuis* on young tobacco leaves.
Imperfect spheriaceæ.
Ascochyta pisi (Anthracnosis of peas). *Septoria anpelina* (Melanosis of the vine). *Septoria piricola* (on leaves of the pear).
Septoria Tritici (on wheat leaves) *Fusicoccum abietinum* (on young pectinal fir-trees). *Diplodina Castaneæ* ("Javart" of the chestnut tree). *Glœosporium ampelophagum* (Anthracnosis of the vine).

Colletotrichum

Colletotrichum Lindemuthtanum (Anthracnosis of beans). *Marsonia Juglandis* (Anthracnosis of the walnut-tree). *Pestalozzia Guepini* (Grey blemishes on the leaves of the tea-tree and the camelia).
Cercospora Apii (spots on the leaves of celery and parsley).
Cercospora coffeicola (in the leaves of the coffee-tree). *Cercospora beticola* (on the leaves of the beet-root). *Scolecotrichum melophthorum* ("Nuile" of melons and cucumbers). *Fusicladium pirinum* (spots on pears). *Fusicladium dendriticum* (spots on apples).
Hypocreaceæ.
Nectria ditissima (canker of trees). *Nectria cinnabarina* (on various trees). *Claviceps purpurea* (Ergot of rye and of the gramineæ).
Epichloë typhina on meadow grasses. *Hypomycae* (Mycogone) *perniciosus* (of the mushroom).
Perisporiaceæ.
Erysipheæ, "White" (*Erysipha. Oïdium*). *Erysipha graminis* ("White" of cereals and of gramineæ). *Erysipha communis* ("White" of numerous plants). *Phyllactinia suffulta* ("White" of the nut-tree and of the ash-tree). *Sphærotheca pannosa* ("White" or Oïdium of the rose-tree and the peach-tree). *Sphærotheca Castagnei* (Oïdium of the hop). *Uncinula americana* and *Oïdium Tuckeri* (Oïdium of the vine). Sulphurs and sulphuration.
The alkaline sulphides. Their use. *Uncinula Aceris* (Oïdium of maple-trees).
Microsphæra Grossulariæ (Oïdium of the red-currant-tree).
Podosphæra tridactyla (Oïdium of the hawthorn, plum-tree, apple-tree) (?).
Perisporieæ,
Capnodium salicinum ("Fumagines" of the willow, of the vine, etc.)
Capnodium Citri ("Fumagines" of the Aurantiaceæ). *Capnodium elongatum* (of the oak, etc.). *Asterula Beijerinckii* (spotting on the leaves and fruits of the Amygdaleæ).
Thielaria basicola (blackening of the neck of the pea of the lupin, of the tobacco plant, etc.)
Diseases produced by phanerogamic parasites—
Rhinanthes and Melampyres, on the roots of gramineæ. Mistletoe (Viscum album), on the branches of various trees.
Cuscutæ.
Cuscutæ of clover, lucerne, flax, of the vine, etc.
Orobanchaceæ : Orobanchæ of clover, hemp, tobacco, etc.
Hypertrophy and deformations due to animals (Galls or Zoocecidiæ)—
Principal types of galls. Their structure.
Nematodes (Galls of *Heterodera radicicola* on the roots of numerous plants).
Acarians (Acarocecidies) : Erinosis of the vine. Brown rust of the Phytoptus Piri, on the pear-tree, etc.
Diptera : Galls of the Cecidomyiæ. Hemiptera : Galls of "Pucerons" (Aphides). Galls of the phylloxera of the vine, etc.
Hymenoptera : Galls of oaks.
Coleoptera : Gall of Ceutorhynchus sulcicollis on cabbages.

17. *Practical Micrographic Exercises in Vegetable Pathology.*—The exercises comprise the graduation of the microscope, evaluation of its magnifying power, the use of the camera lucida.

The micrographic studies embrace non-parasitic pathology, parasites and the lesions occasioned by them, the fungi, the phanerogams, the galls produced by insects and other animals. The work is designed to harmonise with the course indicated in the preceding section.

18. *Microbiology.*—The course in microbiology is as indicated hereunder :—

MICROBIOLOGY.—PROGRAMME OF THE COURSE. (10 LECTURES.)

Importance of microbiology. Cycles of rotation of carbon, hydrogen, nitrogen and oxygen. Rôle of microbes from the point of view of life on the terrestrial surface.
Characteristic properties of microbes. Pleomorphism.
Permanent power.
Classification and reproduction of microbes.
Influence of physical agents on microbes. Action of heat on microbes. Temperature optima and mortal temperature. Important factors for this study. Action of cold. Effects of electricity.
Influence of light on chromogenous microbes and on microbes without colour.
Bacteriological technique. Dry sterilisation (furnace flame).
Sterilisation of liquids and solids. Autoclave Chamberland. Tyndal's method. Sterilisation by cold. Culture and separation of microbes.
Alimentation of microbes. Definitions of aliment. Alimentary qualities of various materials. Factors to be considered. Aliments of growth and maintenance.
Mineral nutrition of microbes (Experiment of M. Raulin) ; Carbohydrate alimentation. Sugars. Nitrogenised nutrition. Aerobiosis and anaerobiosis.
Antiseptics. General ideas Customs of microbes to antiseptics.
Study of the air from a bacteriological point of view. Germs of the air. Quantities and variations. Processes employed.
Microbial study of waters. Operative mode. Results obtained. Purification of potable waters. Porcelain filters, industrial filters. Process of Anderson and process with ozone.
Purification of running or falling water. Industrial filters. Purification by the soil. Aerobic and anaerobic bacterial process of Manchester.
Comparison of various processes.
Microbial study of the soil. Various microbes of the soil.
Nitrification. Nitrous and nitric ferments.
Researches of Schloesing, Müntz, and Winogradsky.
Denitrification.
Assimilation of gaseous nitrogen by microbes which fix nitrogen, by the symbiosis of seaweeds and bacteria, by the bacteria of nodosities of the leguminosæ.
Practical conclusions.
Alcoholic fermentation. Fermentability of various hydrocarbons, various ferments. Origin and properties of the yeasts. Their application in the various industries of fermentation.
Products of alcoholic fermentation. Causes of the production of alcohol. Alcoholic zymase.
Degradation of carbohydrates. Cellulose fermentation : its importance in the decomposition of manure.
Destruction of alcohol. Bloom of wine and vinegar.
Manufacture of vinegar. Processes employed. Diseases of wines, beers, and ciders.
Lactic fermentation. Its importance in the dairy and in the distillery. Butyric fermentation.
Generalities on the decomposition of carbohydrates.
Diastases. General considerations on diastases. Their secretion. Their properties.
Classification of diastases. Laws which govern diastatic action. Amylase. Theories of saccharification. Malt, its reversibility. Sucrase : its properties. Lipase : importance and properties.
Diastases concerned in oxidation and reduction. Researches of M. Bertrand ; useful and injurious rôle of these diastases.
Rennet : its properties : its importance for the dairy.
Alcoholic zymase.
Casease and intervention of microbes in the maturation of cheese.
Mechanism of diastatic actions.
Pathogenic microbes. Saprophytes and pathogenic microbes.
Comparison between the cellules of microbes and those of higher beings.
Disease, virulence, natural or acquired immunity.
Attenuation of microbes (Experiments of Pasteur) ; Vaccine matters. Phagocytosis. Serotherapy.

The above outline shews that the general significance of microbiology is well understood by the students who pass through the National Agronomic Institute.

19.

19. *Physics and meteorology.*—In this course there are thirty lectures, of which twenty-five are devoted to meteorology and its applications, five only being reserved for physics. It must not be forgotten that before entering the Institute the students have already obtained a fairly wide acquaintance with general physics, and optical physics is all that is necessary to develope, since this is not treated sufficiently in the secondary schools.

It is recognised that it would be very desirable that the course should expound the general laws and applications of industrial electricity. This, however, means that the number of lectures should be (say) forty instead of thirty.

It was endeavoured in 1901–2 to make good this defect, by making the pupils of the 1st year attend 7 "*conférences*" on Electricity.

The programme is as follows:—

I. *Programme in Optical Physics.*

5 Lectures.

Velocity of light: its determination, 1° by astronomical observation; 2° by physical methods. Experiments of Foucault, Fizeau, Cornu.

Theory of luminous phænomena. Newton's theory of emission. Young and Fresnel's theory of undulations. Length of waves. Thermal, luminous, and chemical radiations, differ only in wave length. Explanation of phænomena of reflexion and refractions in the wave-theory.

Principle of interferences. Interference fringes. Colours of thin plates. Soap bubbles. Newton's rings.

Diffraction. Synopsis of several diffraction phænomena. Solar and lunar corona.

Double refraction. Study of double refraction in a crystal of one axis. Ordinary and extraordinary ray. Construction of two refracted rays. Nicol prism. Birefracting prism. Polarisation of light. Polarisation by reflexion, by refraction; by the passage of rays through a birefracting crystal. Properties of polarised light. Polarisers. Analysers.

Interferences of polarised light. Polarising microscope. Colours presented by their crystalline plates in light plane-polarised. Coloured fringes in crystals observed in convergent polarised light. Applications to crystallography and mineralogy.

Rotatory polarisation. General laws. Rotatory power of crystals. Molecular rotatory power. Measurement of power of rotation. Polarimeter. Application to the determination of quantity with organic substances. Saccharimetry.

II. *Programme in Meteorology.*

25 Lectures.

Object and divisions of meteorology. Relations with other sciences. Geography, agronomy, hygiene. History.

General methods of calculation. Averages: discussion of their value. Application of graphic methods to the representation of phænomena.

Actinometry. Diurnal and annual variations in the quantity of heat received from the sun in different latitudes. Influence of the atmosphere, and of the absorption it exercises on the solar rays. Measurement of the quantity of heat and light, received by the soil. Actinometers.

Temperature of the Ground. Diurnal and annual variations in the temperature of the soil at different depths. Influence exercised by grassing the soil, and by layers of snow. Variation of mean temperature with depth. Invariable stratum. Augmentation of the temperature with depth.

Temperature of the terrestial Waters. Springs, rivers, lakes. Annual variation. Temperature of the sea at its surface and at various depths. Marine currents. Limits of floating ice.

Temperature of the Air. Influence of the seasons, of latitude, of topographical conditions. Annual variation of temperature. Regular climates, mean, excessive. Variation of atmospheric temperature with height.

Study of the general distribution of temperature in the yearly mean, and in the mean of the different seasons. Extreme temperatures observed in various regions.

Influence of temperature on the phænomena of vegetation. Effects of frosts, of altitude. Limits of different cultures. Influence of temperature on animal life.

Atmospheric Pressure. Apparatus for measuring. The mercury-barometer. Aneroid barometers. Registering barometers. Thermometric hypsometry. Diurnal and annual variation of atmospheric pressure.

Variation of pressure with height. Laplace's formula. Applications. Reduction of pressure to the sea level. Calculation of heights by means of barometric observations.

Wind. Measurement of the direction and velocity of the wind, velocity anemometers, pressure anemometers.

Diurnal variation of velocity and direction of wind. Variation of wind with height. General relations between wind and pressure. Gradient. Theory of atmospheric movements. Relation between wind and temperature. Influence of the earth's rotation: deviation of the wind with the gradient.

General circulation of the atmosphere. Regular winds. Trade winds and counter-trades. Distribution of the wind and of the pressure on the earth's surface. Winds varying with the seasons. Monsoons. Diurnal winds. Land and sea breezes. winds from mountains and valleys.

Meteoric Waters.—Evaporation, measurement of evaporation. Diurnal and annual variations in evaporation. General laws of evaporation.

Humidity of the atmosphere. Elastic force of water vapour. Relative humidity. Apparatus for measuring humidity. Chemical hygrometers by condensation, by absorption. Registering instruments: psychrometers.

Diurnal and annual variations of humidity. Variation of humidity with height. Distribution of humidity on the earth's surface.

Condensation of water vapour; various modes of condensation. Direct cooling; mixing. Laws of condensation in currents of ascending air. Dryness of descending currents. Properties and constitution of clouds and fogs.

Cloudiness. Measurement of cloudiness; heliograph. Diurnal and annual variation of cloud. Generar distribution of clouds on the earth's surface. Study of the movement of clouds. Theil classification. Mean altitude of different species.
Optical phænomena of the atmosphere. Rainbow; halos, parhelia, etc.
Aqueous meteors. Dew; formation of dew; its measurement; practical importance of this phænomenon. Hoar frost, frost, hard frost.
Rain, snow, hail. Rain-gauging.
Pluviometers and their installation.
Theory of the formation of rain. Rains of various origin, convection rains, cyclonic rains, relief rain. Influence of topographical conditions. Influence of forests.
General distribution of rain upon the surface of the globe. Rainy regions, arid regions. Detailed study of the rain in different regions. Pluviometric régime; distribution of the rain in the various seasons. Intensity of fall.
Snow: Constitution and density of snow. Its rôle. Limit of perpetual snow.
Natural utilisation of meteoric waters. Infiltration. Formation of streams. Loss through evaporation and through vegetation. Supply to sheets of subterranean waters, of springs and rivers. Régime and co-efficient of flow of water-courses. Freshets and floods, and their prediction.
The laws of storms. Depression of mean latitudes and cyclones of the tropical regions; their constitution, and the distribution of the wind about the centres of low pressure. Effect of depression on the weather. Local winds produced by the passage of the depressions. The mistral, sirocco, foehn, etc.
The laws of the movement, and of the frequency of barometric depressions and of cyclones; velocities and mean trajectories; various origins of vortex movement; causes by which the velocity may be modified; their trajectory or intensity.
Anticyclones; their constitution and influence on the weather.
Storms. Atmospheric electricity, various forms of lightning. Thunder. Hourly distribution. Storm frequency according to the season and geographical situation. Constitution of storms; storms arising from heat, and from barometric depressions. Hail; its formation; means proposed to prevent it. Terrestrial whirlwinds and waterspouts; their effects; their constitution and relations to storms. Whirlwinds caused by heat.
Prediction of the weather. Basis of prediction of the weather for short periods ahead. Organisation of a service for weather prediction. General principles of prediction. Prediction by isolated observers. Utilisation of observations and local signs; forecasting hoar-frost and spring.
Discussion of attempts for forecasting the weather for long periods ahead.
Cosmic influences. Periodicity of sun spots, discussion of the relations which they have with meteorological phænomena. Discussions in regard to influences attributed to the moon. April moon. Other influences attributed to cosmic causes.
Problem of the variability of climate. Is man able to act on climate? Effect of deforestation, of reafforestation.
Experiments on the production of rain. Conclusions.

20. *Practical exercises in Physics and Meteorology.*—The laboratory work in optics consists of the observation of interferences, refraction, double refraction, polarisation, rotary polarisation, etc.

The laboratory work in meteorology consists in the use of the ordinary thermometer, maxima and minima instruments, thermometers for the temperatures of the soil and automatic thermometric recorders. It also includes barometric measurements, the use of tables of reduction, the dismounting and cleaning of Fortin's mercurial barometer, the handling of the self-registering barometer and of the hypsometric thermometer.

Practical hygrometry and the use of psychrometers and self-registering hygrometers is also undertaken.

21. *The Practical Course in Electricity.*—The work in electricity covers the following ground, viz.:—

I. *Continuous current, electric magnitudes and practical units.*

Hydrodynamic analogies. Definition.

(i) Quantity of electricity, Coulomb, and Ampère hour. Intensity of the electric current.
(ii) Intensity of the electric current; the Ampère.
(iii) Difference of potential, the Volt.
(iv) Electric resistance, the Ohm.

Definition of work, of practical units, the kilogrameter, horse-hour (cheval-heure), the joule, the watt-hour, the hectowatt-hour, etc. Relations existing between these various units.
Definition of energy and practical units, the kilogrammeter-second, the watt, the hectowatt, etc. Relations between the various units.
Ohm's law. Applications. The rheostat.
Joule's law. Energy of continuous current. Applications; Electric heating. The law of derived circuits; the shunt.

II. *Introduction to the study of alternating currents and of electric generators and motors.*

(1) The magnetic field. The unit of the field; the Gauss. Tube of force and flux of magnetic force. Mode of producing a magnetic field; magnets and currents. Magnetic field produced by the current of a coil.
(2) Magnetic properties of soft iron. Magnetic force in a bar of soft iron. Influence of the form of the bar. Coefficient of magnetic permeability. Variation of the permeability with the magnetic field. Variation of the magnetic flux in a bar of soft iron within a coil with the intensity of the current. The phænomena of magnetic hysteresis.
(3) Electro-magnetic action. Expression and direction of the action of a magnetic field upon an element of current.

(4) Coefficients of induction. Mutual induction and self-induction. The unit of self-induction; the Henry.

(5) The laws of the electromagnetic induction; induction in a wire. Expression of the electro-motive force of induction. Direction of the induced current. The three-finger rule. The Maxwell Corkscrew rule. The study of the effects of self-induction in the case of making and breaking of the current. Induction in the mass of a conductor. Foucault currents; how they are avoided in an industrial practice.

(6) Condensers. Definition of capacity and of the unit of capacity. The Farad and the Microfarad.

III.

Alternating current. Period, frequency, pulsation, phase, etc. Intensity. Reactance. Impedance. Influences affecting the reactance and the resistance in the circuit. Intensity and the effect of electromotive force. Expression of the energy of an alternating current.

Their applications. Reaction coil and the regulation of intensity. Transport of energy to a distance. Principal types of transformers. Oscillating discharge of a condenser. Wireless telegraphy

IV. *Method of Using and Producing Electric Current.*

Cells and accumulators. Dynamo electric machines. Generators and motors :—

(1) Cells. Principal types. Cells yielding large quantity for industrial use.
(2) Accumulators, description, use, and maintenance.
(3) Continuous-current generators. The Gramme and Siemens' models. Electromotive force. Various modes of excitation. Multipolar machines.
(4) Alternating current generators. The Gramme model and multipolar machines. Polyphase generators. Three-phase generators. Method of transmitting three-phase current.
(5) Continuous current motors. The Rheostat. Application in electric traction.
(6) Alternating-current motors. Gramme motor and series. Classification of motors. Non-synchronised and synchronised motors. Motors with rotating field. Mode of producing a rotating field. Use of three-phase currents. Trial, and examples of the use of these motors in electric traction.

V. *Apparatus for Electric Measurements and its Use.*

(1) Measurement of electric resistance in metallic wires. The Wheatstone Bridge. Measurement of the resistance of the circuits of an installation. Ohmmeters.
(2) Measurement of intensity and voltages.
(3) Ampèremeters and voltmeters for continuous currents. Thermic ampèremeters and voltmeters. Siemen's electro dynamo meter for continuous and alternating current.
(4) Measurement of the energy of a current. The Wattmeter for continuous and alternating currents.
(5) Measurement of the loss of energy of a current. Description of a meter; its control and standardisation by means of the wattmeter.

VI. *Industrial Applications.*

Several examples of installations :—

(1) Lighting. Incandescent arc lamps. Usual constants. Switches, interrupters, shunts, etc.
(2) Motive power with continuous and alternating current.
(3) Installation of bells and telephones.

VII. *The Influence of Electricity upon Vegetation.*

History of experiments effected up to the present time.

This electrical work is of undoubted importance, and its introduction into the course is recognised as essential.

22. *Applied Chemistry; investigation and analysis.*—During the *first year* the pupils learn to use the reagents and the apparatus of the laboratory, the working of glass, the use of various pieces of heating apparatus, etc., etc.

The laboratory manipulations last from one and a half to four hours; but pupils are authorised to stay for five hours in the laboratory, and most take advantage of the permission. The general outline of work is as follows :—

I. *Setting up of apparatus, and preparation of elementary substances.*

(1) Preparation of hydrogen. (2) Oxygen. (3) Nitrogen protoxide. (4) Nitric acid. (5) Hydrochloric acid. (6) Ammonia. (7) Silica. (8) Methane. (9) Ethylene. (10) Carbon dioxide.

While preparing these substances, their general properties are, as far as possible, examined, and sometimes, also, the properties of the residuary products. For example :—Marble treated by an acid gives off $C.O_2$. This is directed into lime-water, producing a precipitate of calcium carbonate; the flow of $C.O_2$ is maintained until the calcium carbonate is dissolved.

II. *Qualitative Analysis.*

The qualitative analysis is about as follows :—

(1) Study of the specific character of bases. (2) Of acids. (3) Determination of the base of a soluble salt; about five different salts are determined. (4) Determination of the acid of a soluble salt. (5) The acid and base of salts insoluble in water but soluble in acids. (6) Insoluble in both water and acids. (7) Qualitative analysis of the complex fertilisers of commerce.

At the close of the year there is a revision of the programme and practical tests of the student's progress.

The

The work of the 2nd year consists of thirty-two attendances, in which the students pass on to quantitive analysis. These comprise manures, soils, water, the principal animal and vegetable products.

On account of the length of the operations, they are often grouped. Each pupil works individually; the samples given him have been previously carefully analysed in the laboratory and follow a series of products of very different composition. In order that each pupil shall work independently of his fellows, the samples are not identical for all the pupils, and the marks given to each month take account of the exactitude of the ascertained results. The details are as follows :—

(i) Analysis of Manures.

(1) Calcareous fertilisers. The determination of the quantity of lime. (2) Phosphate fertilisers; quantity of phosphoric acid in a natural phosphate; in a super-phosphate. (3) Fertilisers containing potash; quantity of potassium in a chloride; in a complex fertiliser. (4) Nitrogen fertilisers; quantity of nitric acid; of ammoniacal nitrogen, of organic nitrogen. (5) Complete analysis of the complex fertiliser. This includes the determination of nitric, ammoniacal, and organic nitrogen. The quantity of soluble phosphoric acid. Total phosphoric acid, total soluble potassium.

(ii) Analysis of Arable Soil.

The methods employed are determined by the Consulting Committee of the Agronomic Stations. (1) Quantity of organic nitrogen. (2) Of phosphoric acid. (3) Of potassium. (4) Of calcium. (5) Of Iron.

III. *Analysis of Water.*

(1) Determination of the total calcium existing in the state of carbonate or sulphate in water. (2) Quantity of chlorine. (3) Investigation of the nitrites. (4) Quantity of ammonia. (5) Organic matter.

IV. *Analysis of Sugar Beets and of Sugars.*

(1) Density, with temperature corrections, quantity of water, of ash, saline co efficient and purity quotient. (2) Inversion of sugars, determination of glucose by means of Fehling's solution. (3) Analysis of cane and beet-root sugars; quantity of crystallisible sugar, of glucose, of water, of ash. (4) Quantity of crystallisible sugar determined by the saccharimeter.

V. *Analysis of Grain and of Fodder Plants.*

(1) Natural and artificial fodders, meadow grasses, etc., are analysed from the point of view of their nutritive value, and in connection with this the following determinations are made:— (1) Quantity of water (by desiccation); of mineral matter (by incineration); of nitrogen (by Kjeldahl's method); of fatty matters (by washing with ether); of crude cellulose; of carbohydrates. Grain seeds, etc., are treated in a similar way.

VI. *Analysis of Elementary Substances.*

(1) Of milk; determination of density at 15° of dry extract by desiccation; of butter by washing the dry matter with ether; of sugar of milk by titration with Fehling's solution; mineral matters by incineration; analysis of wine; determination of alcohol, dry extract, acidity, ash, *plâtrage.*

At the close of the course the pupils are submitted to a general test, touching several of the matters studied during the year.

Pupils who are admitted for a *Third Year's work* in the Laboratory give the whole of their time during eight consecutive months from 9 o'clock in the morning to 6 in the afternoon, with an interruption of an hour and a half at mid-day (from 12 to 1·30). Beside making a great number of analyses and becoming familiar with the preparation of reagents, of titration solutions, with whole organisation and conduct of the Laboratory, they assist the Professor in all experiments and analyses of the most various kinds.

I. *Analysis of Manures.*

(1) The determination of nitrogenous manures. The determination of nitric, ammoniacal, and organic nitrogen are further studied, and the pupils learn special methods for determining very small quantities.

(2) Phosphate manures. The various fertilising phosphates are passed in review, and the quantity of phosphoric acid in mineral phosphates of different origin, in bone-dust, guano, complex fertilisers, etc., are more fully studied.

(3) Potassium fertilisers. Potassium is determined in chlorides; phosphates, kainite, beetroots, and complex fertilisers are examined by exact methods.

II. *Insecticides, and various agricultural products.*

(1) Copper sulphate and powders. (2) Sulphurs. (3) Carbon disulphide. (4) Cyanogen. (5) Ferrous sulphate, gypsum, etc. Analyses are made of quality, pureness, fineness, &c.

III. *Sampling, and qualitative analysis of fertilisers.*

Not only is a qualitative analysis of manures, from the point of view of their chemical constitution, made, but their proper character, their origin, and physical state are also determined.

IV. *Analysis of arable soil and of various rocks.*

(1) Physical analysis of soil; the separation of calcareous and siliceous matter; determination of the coarseness or fineness; the separation of clay; and quantity of humus.

(2) Chemical analysis of soils; volumetric apparatus for rapid determinations.

(3) Analysis of rocks.

V. *Analysis of water.*

Irrigating and potable waters are more elaborately studied than in the preceding course.

VI.

VI. *Analysis of fodders and seeds.*

Natural and artificial hays from meadows.

The analysis includes the determination of the water, ash, nitrogenous, and fatty matters; the cellulose and carbo-hydrates. It is more elaborate than in the earlier course and the most rigorous processes for determining albuminoid matters, sugar, starch, pectic bodies, etc., are studied.

VII. *Analysis of substances containing sugar.*

The rough yields of sugar-canes and beets are analysed from the point of view of their non-crystallisible and crystallisible sugar-content. The uses of the polarimeter are studied. The whole analysis aims at a complete determination of the industrial value of the substances, and the exigencies of industrial processes are thoroughly taken into account.

VIII. *Analysis of wines, fermented drinks and alcohols.*

(1) Wine.—The alcohol is determined both by Salleron's and by Malligand's apparatus. The dry extract determined by evaporation at a 100°C, by evaporation in vacuum, and by the Œnobarometer.

The total acidity, and volatile acidity, the quantity of potassium bitartrate and tartaric acid and glycerine, tannin, the ash, alcohol, potassium sulphate, are estimated. Since it is an indication of certain diseases, the quantity of mannite is determined.

The wines are examined in respect of their colour, and the principal foreign colouring matters are determined. The students are instructed as to the recognition of alterations in and adulterations of wine, etc.

(2) Beer and cider are equally thoroughly examined.

(3) The alcohols are submitted to fractional distillation; the mode of detecting minute traces by transformation into iodoform and microscopic examination are demonstrated.

IX. *Analysis of alimentary products.*

(1) Milk.—Milk is examined by the creamometer and lactodensimeter. Beside determining the dry extracts, butter, glucose, and ash, the quantities of boric acid and sodium bicarbonate used are ascertained.

(2) Butters.—The proportion of water or butter-milk is ascertained, the adulteration of margarine, the suponification number, and the critical temperature of the alcohol solution. Investigation of antiseptic substances, such as salt, nitrates, boric acid, fluorides, etc.

(3) Oils.—In the oil analysis, account is taken of density, the fatty acids are submitted to the action of nitrous vapours, the solidification and melting point and the iodine value are determined. The characteristics of the principal oils when isolated and when mixed with other oils is ascertained and the mode of detecting the adulteration of one by the other investigated.

(4) Farinas.—Wheaten flours are examined from the point of view of their chemical composition, their milling value, their alteration and adulteration.

X. *Analysis of Tanning Materials.*

The barks, leaves, fruits and, extracts used in industrial tannage are examined in respect of tannin contained, by Loewenthal's and Müntz methods.

XI. *Gas Analysis and Spectroscopy.*

The students learn the use of mercury pumps, volumenometers, eudiometers, etc. They analyse air, mixtures of gases, gases dissolved in liquids, etc.

They accustom themselves to the use of the spectroscope, examine mineral salts, and the principal gaseous substances.

XII. *The preparation of reagents, the organisation of a Laboratory.*

Students are exercised in the preparation of various reagents employed in the analysis of agricultural substances; they investigate their purity, they make titration solutions, and carefully standardise them.

They become *au courant* with the use of various types of heating apparatus, the fuel which is coal, petroleum, alcohol, etc. They study modes of installing and using laboratories, and the commercial relations connected with the purchase, etc., of material and agricultural products.

The thoroughness and practical value of the course above indicated is obvious.

23. *Chemical Analysis and Demonstration.*—This course consists of twenty-two lectures, of which eight are given in the first year and fourteen in the second. The first part is devoted to acquiring a knowledge of and handling the material of a Laboratory so as to facilitate the subsequent manipulation. The second part is devoted to questions of qualitative analysis, and the scheme is designed so as to give as large a number of experimental demonstrations as possible. As it is illustrative of the preceding section it is not proposed to outline it in detail. It is worthy of remark that the question of agricultural bibliography is specially treated, and an enumeration is made of the most important works which an agricultural chemist should have in his library.

24. *Agricultural Chemistry.*—The course in agricultural chemistry embraces forty lectures, covering the question of the living organism, the soil in which it grows, and the science of the amelioration of the soil. The programme is as follows:—

AGRICULTURAL CHEMISTRY.—PROGRAMME OF COURSE.

Generalities.—Aim of the study of agricultural chemistry.

Importance of laboratory studies and of direct experimentation on the soil.

Agricultural chemistry is concerned with the three following questions:—

(1) *The Plant*, its relations with the atmosphere and with the soil; phænomena of vegetable synthesis. Comparison between the life of the plant and that of the animal.

(2) *The Soil*, reservoir of mineral matters; its study, from the point of view of physics, chemistry, and biology.

(3) *Manures*, what should be defined as such; the matter in which the soil is deficient, and of which the plant has need.

A.—Study of the Soil.

Utility of Mineral Matter.—Summary history of the doctrines prior to Liebeig. Before the year 1840, agronomy bestowed attention only on the organic matter contained in the soil, the rôle of the fixed bodies being misconceived.

Mineral theory of Liebig (1840). Rational explanation of fallow land and of the varied succession of crops. Criticism of the theory of Liebig.

Mineral Elements in the Soil.—Actual state of the silica, phosphorus, sulphur, potash, lime, etc.

(1) *Mechanical and Physical Formation of Soils.*—Action of glaciers and torrents, mechanical action of water, mechanical action of the roots of plants.
(2) *Phænomena of Solution due to the action of water charged with carbon dioxide.*

Formation of Soil for Plants.—Mode of destruction of the most important rocks—primitive rocks, volcanic rocks.

All these rocks furnish, by their decomposition, the three fundamental elements of soils—sand, clay, lime.

Formation and strata of tricalcic phosphate.

Micro-organisms considered as creators of arable land.

Origin of organic matter of soils ; its composition.

Rôle of the Atmosphere at the Surface of the Globe.—Carbon dioxide in the air. Summary statement of some studies relative to the presence of CO_2 in the air. Circulation of carbon dioxide on the surface of the globe.

Nitric and ammoniacal nitrogen in rain-water. Quantity of combined nitrogen received by the soil in the space of a year.

Physical Constitution of the Soil.—This includes four kinds of elements—sand, clay, limestone, humus.

Clay.—Its nature, its colloidal properties, its constitution, according to Schloesing.

Humus.—This matter plays at times the rôle of cement in the same way as clay.

Sand.—Its mechanical rôle.

Lime.—Its solution in water charged with carbon dioxide.

Physical Properties of Soils.—Density ; imbibition of earths by water ; imbibition of each element in particular ; consequences.

Hygroscopic character of arable earth ; liability of earths to become dry ; rôle which the fineness of the elements plays ; permeability of earths by water and atmospheric gases.

Classification of Arable Earths.—Permeability ; continuity ; immobility. Study of the soils *in situ.* Influence of the nature of the subsoil on the properties of the soil.

Physical Analysis of Earths.—Processes of Gasparin, of Masure, and of Schloesing.

Chemical Constitution of Soils.

(1) *Constitution of mineral matter.*—Impotency of chemical analysis to make known, in the majority of cases, the degree of assimilability of nutritive substances that the soil contains.

Forms, in the soil, of the most important elements ; phosphoric acid ; quantities contained in the different soils ; employment of diluted acids in order to estimate the degree of solubility of phosphates ; comparison with that which the direct experimentation on the soil gives. Various states of sulphur. Forms under which potassium is met with ; employment of different solvents in order to determine these various forms. States of lime. Absolute necessity of checking the data of chemical analysis by carefully verified cultural tests.

(2.) *Constitution of organic matter.*—Humus, its origin, its composition. Nitrogenized matter which the soil contains acts as a complex amide, the slow decomposition of which engenders ammonia and carbonic gas. Rôle of lime in the decomposition of humus ; rôle of micro-organisms. Presence of ammoniacal ferments in the soil. Emission of ammonia by the soil.

In the soil, the simplification of organic matter is principally the work of micro-organisms. Nature and distribution of these.

Fixation of Nitrogen Gas in the Soil.—Historic ; experiments of Boussingault and of George Ville ; studies of Berthelot on the fixation of nitrogen gas on ternary bodies by means of electric discharge ; fixation on vegetable earth through the medium of micro-organisms. Studies of Winogradsky on the isolation of micro-organism concerned in the fixation of nitrogen.

Nitrification.—Historic. Experiments of Boussingault on the non-intervention of atmospheric nitrogen in nitrification. Conditions of nitrification ; nitric ferment (Schloesing and Müntz) ; studies of Warington and of Munro.

Studies of Winogradsky relative to the isolation, the pure state, of nitrous and nitric ferments ; necessity of the presence of these two ferments in order to completely oxidise ammonia. Purely mineral nutrition of nitrous and nitric ferments. Nitrous and nitric microbes are able to oxidise organic nitrogen, only after it has been changed into ammoniacal nitrogen.

Practical observation [illegible]ication.—Nitrification in the soil ; virgin soil and soil that has been manured. Nitrification of ammoniacal salts and of certain nitrogenized matters. Variability of the energy of nitric ferment. Nitrification in heavy earth and light earths. Inactivity of nitrogenized material of the soil.

Reduction of the nitrates in arable earth.—Studies of Dehérain and Maquenne, of Gayon and Dupetit. Butyric fermentation of arable earth. Formation of nitrous acid, of nitrous oxide, and of free nitrogen during the reduction of nitrates. Ubiquity of the reducing ferments. Fermentative phænomena which are accompanied by the disengagement of nitrogen gas.

Nature and circulation of gases existing in the soil.—Carbon dioxide and its variations ; experiments of Boussingault and Lewy, of Mangin, of Schloesing junior.

Oxidation of organic matter in subsoil ; oxidations produced by chemical action and by the action of microbes.

Study

Study of the solutions contained in soils.—Experiments of Schloesing. Drainage water. Experiments of Lawes and Gilbert, example of virgin soil; example of cultivated earth. Relation of the drainage to the water falling on the soil; composition of drainage waters, drainage in different seasons.

Rôle of organic matter in the soil.—Dialysis of arable earth, experiments of Grandeau. Direct rôle of organic matter in the nutrition of vegetables, alimentation of vegetables by the humus. Indirect rôle of humic matter in opposition to vegetable. Differences between the fertility of land in good state of manuring and that of land exhausted by cultivation. Hypotheses on the utility of organic matter in the soils and experiments in support of these hypotheses.

Causes of the sterility of arable lands.—Bad physical constitution of soils, means of augmenting the arable stratum; substances injurious to vegetables; exhaustion of the soils by cultivation without manure. Manures left by previous dressings; influence exerted on crops by previous dressings; of soluble nitrogenized manures.

Generalities concerning succession of crops.—Practice as to fertilising cultures: plants employed for this purpose, their effect. How the analysis of drain-waters permit of the study of the efficacy of fertilising cultures. Production of nitrates by the leguminosæ and gramineæ employed as green manure; experiments of Dehérain.

Study of the absorbent power of soils in connection with fertilising matters.—What factors enter into play in regard to absorbent power. Physical actions, chemical actions; rôle of lime, of humus, of colloidal silicates. Absorption of ammonia by arable land, absorption of fixed bases, of phosphates. Combinations that connect the humus with the bases; the colloids of the soil, colloidal silica.

Practical observations arising out of the study of the absorbent power.

B.—Study of Manure.

Ideas concerning manure, and amelioration.—When it is necessary to have recourse to manure.

Exigencies of the principal cultures and fertilising elements.—Cereals, leguminosæ, industrial plants, plants with roots and tubercles, meadows.

The study of amelioration should precede that of manure; the amelioration is, in fact, destined to modify the physical and chemical properties of a soil, which can contain a sufficient quantity of matters useful to plants, but which are actually in an inassimilable condition for them.

Principal ameliorations, Calcareous amelioration—Lime, theory of liming, action of lime on the physical properties of the soils and on the mineral and organic elements. Practice of liming, proper season, quantities to be employed, consequences of liming.

Marling.—Definition of marl, its qualities, its layers, Effects of marling, practice of marling, season and quantity.

Comparison between liming and marling.

Magnesian amelioration.

Plastering (*Plâtrage*). Its action on the crops; theory of plastering.

Manures properly so-called.

I. *Organic manures. Farm manure.*

Composition of ejections and litters, production and weight of manure.

Chemical reactions which take place in manure—(1) in the stable, ammoniacal fermentation; (2) in the heap. Origin of manure ferments.

Chemical composition of manure, variations in the composition of manure. Liquid manure.

Loss of fertilising elements in the stable and in the heap; means of avoiding these. Collection and conservation of manure, burying in the ground.

Action on various soils and plants.

Organic manure of towns.—Human ejecta and their employment; dried night-soils. Sewerage and its agricultural employment.

Manures composed of vegetable substances, green manures.

Industrial wastes of various kinds.

Effects of denitrification produced by farm manures.

Experiments of the German school, experiments of Dehérain.

II. *Chemical manures.*

Advantages and inconveniences of their employment.

(1) *Nitrogenized manures.*—Determination of the needs of a soil in nitrogen.
  Nitrates, their employment, their application on various soils.
  Ammoniacal salts generally, and their application on various soils.
  Organic Nitrogen: blood, flesh, horny matters, guanos, etc.
  Agricultural employment of these.
  Comparison between the different forms of organic nitrogen; comparison between the nitrates and ammoniacal salts; velocity of nitrification of different organic manures.

(2) *Phosphate Manures.*—Means of determining the requirements of a soil in phosphoric acid. Forms of phosphoric acid in the soil. Natural phosphates, mineral phosphates, phosphates from bone, phosphoric wastes. Phosphates having undergone chemical treatment. Retrogression of phosphates. Agricultural employment of phosphates, their transformations in the soil. Application to various soils; comparison between the different forms of phosphates.

(3) *Potassium Manures.*—Sources of these. Means of determining the potassium requirements of a soil. Forms of potassium in the soil. Exigencies of crops in potassium. Potassium salts employed in agriculture. Application to the different soils and the different cultures. Comparison of the various potassium salts with one another.

(4) *Sodium Manures. Ferruginous Manures.*

C.

C.—Study of the Plant.

Phænomena of Nutrition in General.—Vegetable nutrition, carbon nutrition at the expense of the carbonic dioxide of the air. Relations of the plant with the soil, mineral nutrition.

Germination.—

(1) Influence of physical agents on the germination, humidity, temperature, oxygen.
(2) Respiration of the grain. Relation which exists between the oxygen consumed and the carbon dioxide evolved; examples of fatty amylaceous seeds, and mixed seeds or grains.
(3) Chemical transformations produced during germination:
  (*a*) Fatty matters and their metamorphosis in carbohydrates; saponification of fats during germination; oxidation of the fatty acids.
  (*b*) Amylaceous matters, their transformations; action of diastases; digestion of cellulose.
  (*c*) Nitrogenised matters and their metamorphoses. Formation of asparagin; velocity of destruction of the proteids. Regeneration of albuminoids at the expense of asparagin.
  (*d*) Migration of mineral matters in germinating seeds. Organic transformations, accomplished under the influence of the absorption of mineral matters.
  (*e*) Evolution of tubercles, bulbs, and buds.
  (*f*) Etiolation.

Physico-Chemical Study of Chlorophyll.—Isolation of this pigment, its nature. Spectrum of chlorophyll; influence of radiations on the production of chlorophyll; influence of temperature, of the presence of certain mineral elements.

Carbon Nutrition of Plants.—Function of chlorophyll or of assimilation.

(1) Nature of the chlorophyllian phænomena. Laws. History of the discovery of the assimilation function; experiments of Boussingault; relation existing between decomposed carbon dioxide and the evolved oxygen. Processes allowing of the study of the chlorophyllian function independently of respiration; experiments of Claude-Bernard, of Bonnier and Mangin. Vegetation in atmospheres rich in carbon dioxide.
(2) Theory of the chlorophyllian function: what are the first terms of the synthesis? Non-decomposition of water during the chlorophyllian assimilation.
(3) Physiological phænomena which accompany assimilation. Apparition, solution, and disappearance of starch. Influence of temperature on assimilation. Means by which the gaseous exchanges are effected.
(4) Influence of calorific and luminous radiations on assimilation. Experiments of Timiriazeff, of Engelmann, and of Reinke.
(5) Direct absorption of organic matters by certain plants provided with chlorophyll. Recent studies on this subject.

Vegetable Respiration.—Definition: Antagonism of the respiratory function and of the function of assimilation.

(1) Hidden respiration: Respiration of organs and of plants deprived of chlorophyll. Experiments on the organs provided with chlorophyll. Value of the ratio CO_2/O. Work of Bonnier and Mangin, of Deherain and Maquenne. Necessity of obtaining the whole of the gas included in the organ considered, in order to estimate the quantity of carbon dioxide produced in respiration. Gaseous exchanges of whole plants.
(2) Inter-molecular respiration. Chemical phænomena of respiration, nature of the compounds which oxidise.
(3) Presence and rôle of the acids in plants. The acidification of the vegetable is the result of incomplete respiration. Significance of vegetable acids. Summary study of the presence of some acids in plants: Oxalic acid.

Nitrogenized Nutrition of Vegetables.

(a) Nutrition at the expense of the gaseous nitrogen of the air.—Contradictory experiments executed before 1886. Works of Hellriegel and Wilfarth on the absorption of nitrogen gas by the leguminosæ (1886); discussion of hypotheses formulated relatively to the ameliorating rôle exercised by the leguminosæ. General results of the experiments of Hellriegel and Wilfarth: the leguminosæ absorb the nitrogen of the air in virtue of the phænomenon of symbiosis; the presence on their roots of particular nodosities, peopled by specific bacteria, is the direct cause of the fixation of nitrogen by these plants.

Study of the nature of root-tubercles and of their contents; different opinions expressed in this regard. Inoculation of roots of leguminosæ growing in a sterilised medium with the contents of the root-tubercles of leguminosæ. Specific character of the species of microbes inhabiting the root-tubercles.

Experiments of Schloesing, junior, and of Laurent on the direct fixation of nitrogen by the leguminosæ. How certain green algæ behave in regard to gaseous nitrogen. Symbiosis of the algæ and bacteria.

Practical consequences of the fixation of gaseous nitrogen. Summary study of *nitragin* and its applications.

(b) Nutrition at the expense of nitric and ammoniacal nitrogen.—Influence of nitric nitrogen on vegetation. Presence and distribution of nitrates in the plant. Rôle of nitrates, their transformation in the vegetable. Influence of light in this transformation.

Assimilation of ammoniacal salts by the plant.

Rôle of nitrates compared to that of ammoniacal salts.

Mineral Nutrition of Vegetables.

Presence of mineral matters in the plant. The analysis of the ashes of a plant do not always give exact information as to its real needs. Value of synthetic cultural experiments in order to discover the rôle of each saline element.

Quantity of ashes left by the various organs of a plant: Roots, stems, leaves: composition of ashes. Distribution of the various elements of the ashes in the various organs. Synthetic

Synthetic cultures in the liquid and solid artificial centres.

Physiological rôle of the principal mineral elements: phosphoric acid, potassium, lime, iron, manganese, etc.

Assimilation of mineral substances.—States in which phosphoric acid, calcium, potassium, silicon, sulphuric acid, are found in plants. Mechanism and cause of the absorption of mineral matters: excretion of roots.

(a) Explanation of the absorption derived from the study of phænomena of diffusion (Dehérain), accumulation of soluble and insoluble salts, accumulation of phosphates, of silicon, of potassium, of nitrates: accumulation in the leaves of substances soluble in carbon dioxide.

(b) Explanation of the phænomena of saline absorption derived from the study of osmotic pressure.

Growth of Plants.

(*a*) Migration of organic matter in the plant: This phænomena is governed by the movement of water. (1) Study of the absorption of water by the root; (2) Ascension of water in the stem, capillary phænomena, phænomena of osmotic pressure; (3) transpiration of water by the leaf, influence of the age of the latter; laws of transpiration, influence of radiation on transpiration.

Growth in an annual plant, migration of the principal matters containing carbon or nitrogen; differences which exist in the annual plants, relatively to the migration of the nitrogenous matters according as their efflorescence is rapid or slow.

(*b*) Example of the migration of the principal hydrocarbons in beet-root; accumulation of sugar. Example of migration in the potato.

(*c*) Migration of mineral matters accompanying that of the organic principles. Accumulation of phosphates and albuminoids in the seed.

(*d*) Mechanism of the migration of the immediate principles; accumulation of insoluble reserves. Phænomena of migration accompanying the removal of the ovules.

Maturation.

Maturation of amylaceous and oleaginous grains and seeds; maturation of fruits; examples taken from among the fruits in which the acids, tannin, and starch predominate.

Physiological study of the formation of several immediate principles.

(a) Non-nitrogenised principles.—Pentoses, gum (of wood), their genesis in the plants, their rôle; manner of characterising them. Hexoses; celluloses, dextrines, polyglucoses, amylaceous matters. Vasculose, lignification of vegetable tissues.

Gummy matters; fats; wax, their genesis in the plants, and their rôle.

Tannins; origin and physiological rôle.

Pectic compounds: pectic fermentation, influence of the presence of lime in this fermentation.

(b) Nitrogenous principles.—Vegetable albuminoids and their differentiation; alkaloids, their genesis and rôle.

(*c*) *Summary study of several soluble ferments producing phænomena of hydratation, etc., of oxidation in the vegetable tissues.*

(1) Hydrolising ferments: Invertine, maltase, amylase, inulase, cyto-hydrolytic ferments. (2) Ferment of glucosides: emulsine, myrosine. (3) Soluble oxidising ferments or oxydases, laccase, tyrosinase; rôle of manganese in the action of oxidising ferments.

The comprehensives of this outline of agricultural chemistry is obvious. It will not be adequately appreciated, however, unless it is realised also that the rapid discovery of new facts are communicated as fast as they are made.

The Professor, M. G. André, has produced a large number of original theses in collaboration with M. Berthelot, whose eminence in the field of synthetic and agricultural chemistry is world-wide.

25. *Organic chemistry as applied to agricultural industry.*—The programme in applied organic chemistry consists of thirty lectures, and is systematically divided into a consideration of the acyclic (or open-chain) and cyclic (ring) compounds. The programme runs as follows:—

ORGANIC CHEMISTRY APPLIED TO AGRICULTURAL INDUSTRY—PROGRAMME OF THE COURSE.

(30 Lectures).

Preliminary Notions.

Organised bodies and organic bodies, distinction; definition of organic chemistry; formation of organic compounds, and relations existing between them, development of this idea, taking as example the carbides of hydrogen; determination of the chemical composition by means of four operations:—

(*a*) *Immediate analysis*, indication of the various methods employed in order to separate the bodies one from another;

(*b*) *Elementary analysis*, to determine the quantity of carbon, of hydrogen, and of nitrogen;

(*c*) *Determination of molecular weight*, vapour density, cryoscopy;

(*d*) *Determination of chemical function*, relations between the constitution of a body and its various chemical reactions.

Principal chemical functions; language adopted in organic chemistry; principles of its nomenclature; empirical formula and constitutional formula.

Homology, general formulæ by means of which homologous bodies may be represented; isomerism, isomers, polymers, stereo-isomers, rotatory power.

Division of organic chemistry; acyclic series (open chain compounds), cyclic series (ring compounds).

ACYCLIC

Acyclic or Fatty Series.

I. *Simple Substances.*

(1) *Carbides of Hydrogen.*

(*a*) *Saturated hydrocarbons or paraffins.*—Methane and its homologues; petroleums of America, origins; raw mineral oil refining; petroleum ether, lamp oil, lubricating oil; solid carbides; vaseline, paraffin; applications of these various products.

(*b*) *Non-saturated hydrocarbons.*—Ethylene carbides, or olefines; ethylene, amylene; distillation of coal, lighting gas, compressed gas, apparatus for carburetting.

Acetylene; preparation by means of calcium carbide; uses from the point of view of lighting.

(2) *Halogen derivatives.*

Methyl chloride, its production by utilising the "*rinasses*" of beet-root; ethyl chloride; ethylene chloride, ethyl iodidide, chloroform, iodoform.

(3) *Alcohols.*

Monalcohols or mono-hydroxyl derivatives; methylic alcohol; commercial methylene, sources of production, use as a denaturant, discussion of the problem of denaturating. Ethylic or ordinary alcohol; chemical theory of its formation, physical properties of anhydrous (absolute) alcohol, its chemical characteristics as regards an understanding of its various uses in technology. Principal higher alcohols; propylic, butylic, amylic, their presence in the potato oils. Solid alcohols; cetylic alcohol or ethal, in spermaceti.

(4) *Acids.*

Monobasic, or fatty acids: Formic acid, preparation and principal properties. Acetic acid; various sources of production; acid of alcoholic liquors, vinegars; acid arising from the treatment of the products of the distillation of wood, pyroligneous acid, white acetic acid, crystallisable acid, physical and chemical properties, principal uses; the most useful acetates and "*pyrolignites.*"

Higher acids; propionic, butyric, valeric, capric; solid fatty acids; lauric, palmitic, stearic . . their importance from the point of view of the constitution of fatty substances and their applications.

Acid derivatives.—The chloracetic acids; acetyl chloride; acetic anhydride.

(5) *Aldehydes and Acetones.*

(*a*) *Aldehydes.*—Formic aldehyde or "*formol*" preparation and applications, importance of the formol considered as a first hydrate of carbon (constitution of saccharine, amylaceous, and cellulose bodies). Ethylic aldehyde, its formation and relations to ordinary alcohol.

(*b*) *Acetones.*—Ordinary acetone, obtained from the products of the distillation of wood, accompanying methylene, principal usages.

(6) *Ethers.*

Definition and division into two groups.

(*a*) *Ether-oxides.*—Methyl oxide; ethyl oxide or ordinary ether, preparation, properties, uses as a solvent.

(*b*) *Ethereal salts.*—Derivatives of mineral acids; ethyl nitrate; amyl nitrate; ethyl sulphate; sulphovinic acids and sulphovinates. Derivatives of organic acids; ethyl acetate; amyl acetate; . . . and in general the fruity ethers; solid ethers; bees'-wax, China wax, spermaceti.

(7) *Nitrogen compounds.*

Various nitrogen groups able to exist in a chemical molecule.

(*a*) *Nitrous and nitric derivatives:* examples.

(*b*) *Amines* or ammoniacal compounds; natural state and modes of formation, general properties; quaternary salts of ammonium.

(*c*) *Amides:* preparation of the acetamide and of analogous bodies.

(*d*) *Alcoholic cyanides:* nitriles and carbylamines; cyanhydric acid, its presence in certain plants, its properties; metallic cyanides; potassium cyanide; double cyanides, ferrocyanide and ferricyanide.

Products of the oxidation of cyanides; potassium cyanate; ammonium cyanate.

(8) *Incomplete compounds.*

The Allylic series.—Allylic alcohol; acroleïn, its formation in the pyrogenesis of fatty bodies; allyl-sulphide (essential oil of garlic). Allyl-sulphocyanide (essential oil of mustard). Oleic acid; considered as a non-saturated fatty acid, its presence in fatty bodies, its employment in the manufacture of soaps.

II. *Multiple Compounds.*

(1) *Polyalcohols.*

(*a*) *Dialcohols or glycols:* Genera preparation, properties, the glycolic ethers.

(*b*) *Trialcohols: Glycerine* natural state, extraction, purification, physical and chemical properties, principal usages. Glycerine ethers.

Mineral glycerides. Examples: nitroglycerine, phosphoglyceric acid.

Organic glycerides. Examples: Acetin, butyrin, palmitin, stearin.

Natural fatty bodies.—Solids: butter, tallow, fat, etc. Liquids: fatty oils and drying oils; difference of constitution from the point of view of the fatty acids, various applications. Manufacture of wax candles and soaps.

(*c*) *Higher polyalcohols:* Erythrite; arabite; rhammite; mannite, its extraction from manna, its properties; dulcite; sorbite; perseite; inosite.

(2) *Oxidation products of the polyalcohols.*

The oxidation can be total or partial, giving rise to either polybasic acids or acid alcohols.

(*a*) *Dibasic acids:* Oxalic acid, its presence in certain plants, its industrial preparation, its properties and its uses; principal metallic oxalates and oxalic ethers.

Malonic acid; succinic acid, succin, fermentation, its presence in fermented liquids, example of the complete synthesis of an organic compound; higher dibasic acids; oxidation of fatty bodies.

(*b*) *Alcohol acids:* Lactic acid; fermentation of milk, of muscles; inactive and active acids.

Vegetable acids.—Malic acids, its presence in fruits; tartaric acid, constitution, stereo-chemical modification, treatment of raw tartars, uses. Principal tartrates, double salts, emetics; citric acid, extraction from fruits, preparation, etc.

(3) *Complex Nitrogenous Compounds.*

Association of various nitrogenous functions, alcohol, acid.

(*a*) *Diamines* or ethylene-amines; some examples; ptomaines, ammoniacal oxyethylenes, or amino-alcohols, cholin, neurin, muscarin.

(*b*) *Diamides.*—Examples; carbamide or urea; its extraction from urine, its synthetic preparation; general properties, importance from the point of view of the formation of ammoniacal salts.

(*c*) *Amide acids*, considered as products of dissimulation of nitrogenous bodies; glycocoll, sarcosin, alanin, butalanin, leucin. Aspartic acid; asparagin, its presence in plants.

(III.) *Carbohydrates.*

(1.) *Saccharine substances.*—Definition and classification of sugars according to their constitution; general properties; reducing power; principal reagents used in separating them.

(*a*) *Monoses* or non-hydrolysable sugars.

Sugar of an aldehyde nature (aldoses), and sugars of an acetonic nature (acetoses).

Description: *Pentoses*: arabinose, xylose, rhamnose.

Hexoses.—Glucose group; ordinary glucose, theory of its formation, its properties, its decomposition into alcohol and carbon-dioxide; galactose from the decomposition of sugar of milk, group of fructoses; ordinary levulose, separation of glucose; sorbinose.

(*b*) *Polyoses* or hydrolysable sugars.

Sugar from cane or beet-root, physical properties, chemical characters on which the sugar industries are based; milk-sugar or lactose; malt-sugar or maltose; raffinose or melitose; melizitose, etc.

(2) *Condensed Polyoses.*

Passing of sugars to the condition of condensed polyoses, and reciprocally.

(*a*) *Amylaceous substances and Dextrins.*—Starches, feculæ, action of diastases and mineral acids, transformation into glucose; soluble starch, glycogen, inulin. Dextrin; varies of dextrin; commercial dextrin, its preparation, its properties, its various usages.

(*b*) *Cellulose substances.*—Cellulose, its purification, physical and chemical properties; action of sulphuric acid, vegetable parchment; action of nitric acid, gun-cotton, collodion, artificial silk, celluloid; action of alkalis, mercerised cotton. Paracellulose, metacellulose, hydrocellulose, oxycellulose.

(*c*) *Gums.*—Gum arabic, gum Senegal, gum tragacanth, mucilages, relationship to the pentoses and the hexoses.

(*d*) *Pectic compounds.*—Pectin, pectosic acid, pectic acid, pectase, metapectic acid; relations with the pentoses and galactoses.

Vasculose, ligneous, and incrusted substances, etc.

CYCLIC SERIES—RING COMPOUNDS.

I.—*Benzene or Aromatic Compounds.*

(1) *Aromatic Carbides.*—Origin of these carbides, treatment of coal tar; light, medium, and heavy oils, tar, pitch.

(*a*) *Principal Carbides.*—Benzene, toluene, xylenes, cymenes, cinnamene, naphthalene, anthracene; their principle usages.

(*b*) *Derivatives.*—Sulphonic acids and sulphonates; nitrate derivatives, nitro-benzene.

(2) *Phenols.*—Ordinary phenol or phenic acid, its extraction and uses; synthetic preparation of the phenols. Diphenols: pyrocatechin, resorcin, hydroquinone. Triphenols: pyrogallol or pyrogallic acid. Naphthols.

(3) *Aromatic Amines.*—Aniline, preparation and properties; toluidines, naphthylamines.

Importance of these amines from the point of view of the manufacture of the so-called aniline dyes.

(4) *Aromatic Acids.—Aldehydes.*—(*a*) *Acids*, benzoic from benzoin from the herbivera—hippuric acid, cinnamic acid.

Oxyacids: Salicylic acid, gallic acid, tannins and tanning matters. Dibasic acids: phthalic acid, phthaleïns, fluoresceïn, eosin.

(*b*) *Aldehydes.*—Benzoic aldehyde, or essence of bitter almonds; salicylic aldehyde; vanillin, natural and artificial product.

(5) *Vegetable Dyes.*—Natural indigo and artificial indigotin; extract of madder, natural alizarin and artificial product, purpurin, hematoxylin, red woods, yellow vegetable colourings, turnesol, chlorophylls.

(6) *Essential Oils and Resins.—Terpenes.*—Essence of terebinthine, indigenous and foreign varieties, uses; essential oil of citron; gallipot, colophony; essential oils: bergamot, citron, orange, lavender, geranium; ordinary camphor, caoutchouc, gutta-percha.

II. *Complex Bodies.*

(1) *Glucosides.*—Presence in plants of a multitude of aromatic bodies in the state of glucosides; oxygen and nitrogen glucosides.

Examples: Salicin, coniferin, amygdalin, indican, myronic acid, etc.

(2) *Vegetable Alkaloids.*—Principles for extracting an alkaloid; general properties, reagents.

Examples: Alkaloids of opium, morphine, codeine; alkaloids of the cinchonas, quinine, cinchonine, nicotine, cicutine, etc.

Principal Constituents: Pyridine and quinoleïn.

(3) *Proteid Substances.*—Constitution and general characters, reactions, chemical composition.

(*a*) *Albumins.*—Coagulables or solubles: albumin of the egg, blood, vegetable albumin. Coagulable or insolubles: fibrins, caseins, glutens, etc.

(*b*) *Albuminoids.*—Soluble: gelatine, glue, isinglass, chondrin. Insolubles: ossein, cartilageïn, keratin, chitin.

(*c*) *Products of Transformation.*—Alkali-albumins, basic digestion; acid-albumins, acid digestion, syntonins, peptones, albuminoses.

(*d*) *Diastases or Enzymes.*—The constitution of these bodies approximate to those of the albuminoids; examples of diastases inducing phænomena of hydratation, of dehydratation, of oxidation, of reduction, of coagulation.

The course just outlined is sufficiently thorough to give the student at least clear ideas of the relation of organic chemistry to the products with which agriculture is concerned.

26. *Course in Mathematics.*—A course of twenty lectures in mathematics is given which may be briefly outlined as follows:—

Combinations, binomial formulæ, series, limit of $\left(1+\frac{1}{m}\right)^m$ for $m = \infty$. Projection theorem. Rectilinear co-ordinates in a plane; the equation of a straight line and exercises thereupon. Rectilinear co-ordinates in space. Equations of straight line, and plane and exercises thereon. The formulæ of spherical trigonometry deduced from formulæ established between a straight line and plane. Legendre's theorem.

Theory of functions. Continuity. Singularities. Discussion of functions.

Derivatives: sums, products, quotients, functions of functions. Formulæ relating to simple functions. Theorems of Rolle and Taylor.

Conceptions of the infinite and infinitely small, differential notation, complex and implicit functions. Conceptions concerning integrals and integration.

Geometrical applications. Representation by means of curves. Tangents. Curvature, arcs. Special study of the ellipse, parabola, and hyperbola defined by means of their focal properties. Equations of these curves referred to their axes. The equilateral hyperbola referred to its asymptotes. Deduction of the more simple properties of these curves from their equations. Tangents, asymptotes, areas. Curvature of casks, etc.

Tangent-planes. Cones, cylinders. Brief reference to surfaces of revolution.

The final lecture of the course is devoted to considerations as to the utility and philosophic significance of the mathematical sciences, and refers also to the most important parts of the course. The professor being M. Laurent, whose distinguished contributions to mathematics since 1865 are well known, it is needless to say that to properly-prepared students the lectures are of very high value.

27. *Agricultural Mechanics.*—The chair is one for both agricultural mechanics and hydraulics. We shall deal with them here separately.

The present organisation is the result of considerable experience and rearrangement.

PROGRAMME OF THE COURSE IN MECHANICS. (20 Lectures.)

Kinematics.

I. *Motion of a Point.*

Trajectory.—Equation of motion along a trajectory. Uniform motion, velocity, non-uniform motion and velocity, direction of velocity, value of velocity. Uniformly accelerated or retarded motion. Projection of motion on a fixed plane, or on a determinate straight line.

Angular velocity.

Simultaneous motions of a point. Composition of two uniform and rectilinear motions. Composition of any two motions whatsoever. Composition of three simultaneous motions. Decomposition of a velocity into several others.

Acceleration, composition of accelerations, tangential acceleration, normal or centripetal.

II. *Movement of a Solid or Invariable System.*

Motion of translation. Motion of rotation. Sliding and rolling motion. Elementary motion of a solid, the points of which are displaced parallel to a fixed plane. Elementary motion of a solid, one point of which remains fixed. Elementary motion of a solid which is displaced in any manner whatsoever in space. Simultaneous motions of a solid.

Dynamics.

I. *Equilibrium and Motion of a Material Point.*

Material point. Principle of dynamics, and definition of force and mass.

First Principle.—Inertia of matter. Definition of force.

Second Principle.—Independence between the effect of a force and the previously acquired motion of the material point on which the force operates. Definition of mass.

Third Principle.—Equality of action and of reaction.

Fourth

Fourth Principle.—Independence of the effects of forces which act simultaneously on one and the same material point. Composition and decomposition of forces. Units of force and of mass. Tangential force, centripetal force.

Motion of a material point subject to the action of gravity.

Moments of forces applied to a material point. Moments with respect to a point. Moments in respect to a straight line.

Motion of a point on a curve or on a surface.

Work of Forces. Work in the case of a displacement in the direction of the force. Work in the case of any displacement whatsoever. Work of several forces applied to a material point. Work of gravity.

Theorem as to the quantity of motion. Theorem of *vis-viva.* Potential, actual, and total energy. Force of inertia. Centrifugal force.

II. *Equilibrium of Material Systems.*

Molecular constitution of bodies.

Composition of forces applied to an invariable solid.

Point of application of a force. Composition of concurrent forces. Composition of parallel forces. Couple.

Moments of parallel forces in relation to a plane. Moment of a surface.

Centre of gravity. Centre of parallel forces. Centre of gravity of a solid. Theorems facilitating the determination of the centre of gravity. Various examples of centres of gravity.

Work of gravity in the motion of a material system. Reduction of forces applied to an invariable solid.

General conditions of the equilibrium of a free invariable solid. Conditions of the equilibrium of an invariable solid which is not free. Equilibrium of a solid which has a fixed point. Equilibrium of a solid with a fixed axis. Equilibrium of a solid resting on a fixed plane.

Application of the equations of equilibrium to simple machines. Lever. Wheel and axle. Pulley. Block and tackle. Differential pulley and wheel and axle. Inclined plane. Equilibrium of natural solids. Initial friction. Equilibrium of natural solids, taking account of the friction. The inclined plane.

Resistance of materials. Extension. Law of tension. Law of elongations. Compression. Law of compression. Deflection—(1) Problem; examination of the load. (2) Problem; examination of the section. Solids of equal resistance. Torsion.

III. *Movement of Material Systems.*

Theorem of the quantity of motion.
Theorem of the *vis-viva.*
Motion of natural solids.
Theory of impact.
Friction during motion. Sliding friction of sliding.
Rolling friction.

IV. *Mechanical Equivalent of Heat.*

V. *Machines.*

Passive resistances. Yield.

Power. Horse-power of steam-engine.

Living motors. Work of man. Work of animals.

The steam-engine. Production of steam. Theoretical work.

Indicated work and study of distribution. Useful work. Boilers. Machines. Locomotives.

Gas, petroleum, and alcohol engines. Combustion of gaseous mixtures. Various combustible gases. Various types of motors.

Motors of the first type. Motors of the second type. Lubricating regulators (governors). Power and yield.

Dynamometers. Traction dynamometers. Rotation dynamometers.

This course is preparatory to that given immediately hereunder.

28. *Agricultural Hydraulics.*—The course in agricultural hydraulics will be briefly outlined:—

PROGRAMME OF THE COURSE OF AGRICULTURAL HYDRAULICS.

DEFINITION OF FLUIDS.

Hydrostatics.

I. *Pressure in a point of fluid.*

Pressure about a point. Level surfaces.

Pressures in a liquid. Pressure at a point in a liquid. Pressure of a liquid on a surface. Centre of pressure. Principle of Archimedes. Equilibrium of floating bodies.

Hydrodynamics.

Hypotheses and definitions. *Cases* where the law of hydrostatics can be applied to the liquids in motion.

I. *Theorem of Bernouilli.*

II. *Flow of fluids through orifices.*

Flow of a liquid through an orifice in a thin plate.
Contraction of the vein. Circumstances leading to a variation of the co efficient of contraction.
Flow through a submerged orifice in a thin plate.
Flow of gases through an orifice.
Flow through a weir. Gauging of small watercourses in sloping grounds.

III. *Effects of a sudden widening of section and flow through adjutages.*

Theorem of Bélanger. Flow through adjutages. Cylindrical pipe. Convergent and divergent adjutages.

IV. *Flow of fluids in pipes.*

Loss of head due to the friction of water in cylindrical pipes.

Formula for the flow of water in a cylindrical rectilinear pipe of constant diameter :—(1) Problem : Determination of the discharge. (2) Problem : Determination of diameter. (3) Problem : Determination of the loss of head.

Evaluation of losses of head at particular points of a conduit.

Different systems of conduits. Flow of gases in pipes.

V. *Flow of water in open canals.*

Variation of the velocity at different points of the transverse section of a canal.

Velocity which should not be exceeded in canals. Slope. Section. Formula for the flow of water in canals. Interpretation of the values of the co-efficients of flow. Relation between the slope and the section. (1) Problem : Determination of the discharge. (2) Problem : Determination of slope. (3) Problem : Determination of the section.

VI. *Pressure of a fluid in motion on a solid.*

Pressure of a liquid vein against a plane.
Gauging water-courses. Gauging apparatus.

Hydraulic motors.

General equation of the work of the hydraulic motors. Discharge, power. Classification of the hydraulic motors.

I. *Rustic motors.*

Various forms of water-wheels.

II. *Industrial motors.*

Water-wheels with buckets. The Sagebien wheel. The Pelton wheel. The Poncelet wheel. Turbines. Machines operated by means of a column of water.

I. *Windmills.*

Régime of the wind.
Windmills for millers., etc,

II. *Windmills with automatic regulators.*

Mills of the first system; of the second system. Power of automatic windmills. Windmill regulator. Establishment of a windmill.

Elevators.

Dynamic yield. Yield in volume. Classification of elevators.

I. *Machines of the First Class.*

Scoop. Tympan. Archimedes screw. Persian wheel, etc., etc.

II. *Machines of the Second Class.*

Suction pumps. Height of suction. Maximum velocity of the piston. Organs of the suction pumps. Different systems of suction pumps. Yields.

Semi-rotatory pumps. Rotatory pumps. Centrifugal pumps.

III. *Machines of the Third Class.*

Hydraulic ram. Elevator of M. de Caligny.

IV. *Pulsometers.—Air-pumps.*

V. *Pulverisers.*

Irrigation.

I. *Hydrology.*

Rains. Rivers. Rivers of Italy; of France; of Spain; of Algeria; and of Tunis.

II. *Different origins of Irrigation Water.*

Circulation of water in the soil.
Wells. Wells of great discharge. Wells of small discharge.
Springs. Reservoirs. Small and large reservoirs.
Elevation of water by machinery.

III. *Irrigation by means of Canals.*

Principal, secondary, and tertiary canals.

IV. *Distribution of the Water.*

Time of distribution. Flow dividing. Modules.

V. *Methods of Irrigation.*

Irrigation by distribution: by submersion; by infiltration. Management of the soil.

VI. *Irrigated Cultivations.*

Rice-fields.

Meadows. Permanent meadows on sloping grounds. Permanent meadows on flat grounds Temporary meadows.

Artificial fodder: Maize, wheat, flax, and hemp. Roots and tubercles. Varied succession of crops. Kitchen garden cultures.

Vines, olives, oranges, dates.

Cultivations irrigated by sewerage.

VII. *Economic Results of Irrigation.*

Greater value through irrigation. Development of irrigation in various countries.

Colmatoge.—(Raising of land by flow of water containing silt deposits).

I. Methods of colmatage.
II. Works executed of reclamation and colmatage.

Drainage for Irrigation of Lands.

I. Scheme for the drainage.
II. Execution of the drainage.
III. Drainage works executed.

Drainage for the Drying of Lands.

I. Methods of drainage for drying. Drying by ameliorating work. Drying by continuous drainage; by discontinuous drainage; by mechanical elevation.

29. *Practical work in Mathematics.*—Both in the course in mathematics, and in the hydraulic course, actual work is done by the students at the so-called "*conferences.*" For example, in *Algebra*, there is a programme of problems involving practical and negative indices, combinations, the binomial theorem; the limit of $\left(1+\frac{1}{m}\right)^m$, the exponential function, logarithms, the calculation of derivatives, Taylor's series, Maclaurin's formula.

In *Analytical Geometry* the work covers plane geometry, cartesian and polar co-ordinates, the straight line, circle, general curve of the second degree, tangents and normals, solid geometry, the plane, right line and sphere.

In the *infinitesimal calculus* the ground covered touches the infinitely small, differentials and derivatives, indefinite and definite integrals, lengths of arcs, radius of curvature; integration by parts, by change of the variable, evaluation of a plane area, use of Simpson's formula, the applications of the infinitesimal calculus to problems of geometry, mechanics, and physics.

30. *Practical applications in Mechanics and Hydraulics.*—The important work done in this way embraces during the *first year*, *three topographical surveys*, which are made in the field by the students. During the *second year*, a large number of drawings are made:—

(1) Study of drainage.
(2) Six sheets of parts of machines. During the time these are executed explanations are furnished as to their use, the reason of their forms, etc.
(3) Sketching of groups of parts of machines "from nature."
(4) Fair copy on a selected scale of the last.
(5) Sketch of the surface of a modern "*versoir.*"

In the applications of general mechanics, calculations are made as to—

(1) Friction on an inclined plane.
(2) The resistance of materials.
(3) The equilibrium of bodies.
(4) The mechanical work of an hydraulic press.

In

In the applications of agricultural hydraulics the work embraces calculations to determine,—

(1) The necessary diameter of a conduit.
(2) The real discharge of a conduit presenting special features.
(3) The necessary section of a canal to afford a given discharge.
(4) Dimensions and form necessary for minimum section.

So as to compel the students to do their work personally, each has a problem with different data. These are so selected as to accustom the pupils to work logarithmically.

The laboratory work involves :—

(1) Experiments with steam-engine ; (2) the use of the Watt indicator, etc. ; the determination of the indicated and the effective work ; (3) study of explosion motors (gas engines, etc.); (4) the rotation dynamometer ; (5) Amsler's planimeter ; (6) gauging apparatus.

31. *Mathematics and Topography.*—The course in which mathematics and topography are combined comprises forty lectures. Candidates for the National School of Woods (Waters) and Forests (Ecole nationale des Eaux et Forêts) are instructed and examined by the "*Maître de Conférences,*" and take specially the following course :—

MATHEMATICS AND TOPOGRAPHY.—PROGRAMME OF THE COURSE.

1. *Mathematics.*

Arithmetic.—Definition of absolute and relative error. Summary theory of relative error Exercises.

Algebra.—Numerical inequalities. Inequalities of the first degree.
Equation of the second degree (the theory of imaginaries are not treated).
Relations between coefficients and roots. Nature and signs of roots.
Study of the trinomial of the second degree. Changes of sign.
Inequalities of the second degree.
Problems of the second degree. Questions of maxima and minima which can be treated by the solution of an equation of the second degree.
Arithmetic and geometrical progressions.
Sum of the squares of the first n whole numbers.

Geometry.—Motion of rotation about a point. Every displacement of a plane figure, of invariable form, in its own plane, may be reproduced by a rotation and a translation.
Use of the rule and compass. Protractor. Elementary problems and geometrical loci.
Area of a regular convex polygon. Area of a circle, of a sector, and of a segment of a circle. Ratio of the areas of two circles.
Dihedral angle. Right dihedral. Plane angle corresponding to a dihedral angle.
The ratio of two dihedral angles is the same as that of their plane angles.
Planes perpendicular to one another.
Trihedral angles. Each face of a trihedron is less than the sum of the two others. Limit of the sum of the faces of a trihedron. Supplementary trihedra.
In every trihedron, each dihedron plus two right angles is greater than the sum of the two others. Limits of the sum of the dihedrons of a trihedral angle.
If the edges of any trihedral angle whatsoever be prolonged beyond its vertex, a new trihedral angle is formed which cannot be superimposed upon the former, although it is composed of the same elements. Exact definition of the elements of a trihedron. Cases of equality of trihedrons.
Right cone with circular base. Sections parallel to the base. Lateral surface of a cone, of the truncated cone with parallel bases. Volume of a cone and of the truncated cone with parallel bases.

Sphere.—Plane sections, great circles, small circles.
Poles of a circle. Given a sphere to find its radius by a plane construction.
Tangent plane.
Measurement of the surface generated by a regular bent line turning about one of its diameters. Area of the zone. Area of the sphere. Measure of the volume generated by a triangle turning about an axis taken in its plane, through one of its vertices. Application to the volume generated by a regular polygonal sector turning about one of its diameters. Volume of a sphere. Volume of a spherical segment.

Trigonometry.—To transform the sum of two trigonometrical lines, sine, cosine, or tangents, into a product.
Use of the trigonemetrical tables to five decimals.
Relations between the angles and the sides of a triangle.
Solution of triangles. Application of trigonometry to the different questions relative to the preparation of plans.
Solution and discussion of some simple trigonometrical equations.
Trigonometrical solution of an equation of the second degree.

Cosmography.—Celestial sphere. Principal constellations. Diurnal movement. Right ascension and declination.
Spherical form of the earth. Determination of longitude and latitude. Radius of the earth. Geographical maps.

Sun.—Apparent movement in the celestial sphere. Ecliptic, zodiacal constellations. Inequalities of days and nights. Seasons—their inequality. Measurement of time. The calendar.

II.

II. *Topography.*

In the second year, the teaching of topography is purely practical. Its aim is to put into practice the theoretical and practical knowledge acquired during the first year of studies. With this object in view, the pupils are conducted to the ground of which they are to make a complete plan.

During the last few years, the ground selected has been the upper island of the Bois de Boulogne. As this island is very elongated, two topographical polygons, united by a common side, which divides the island into two almost equal parts, have been available.

The pupils are divided into four groups of six pupils. Two groups are assigned, one to each polygon, so that they can simultaneously operate without inconvenience.

The plan of the island is made by the group; the pupils of one and the same group divide the work and establish a rotation, in order that each pupil may practise successively the various operations that a plan includes. They use the instruments which they learned to manipulate in the first year.

At the first attendance, the duration of which is four hours, each group thus surveys one-half of the island. The work is finished in a second attendance of the same length.

All the measurements and the various outlines taken in common by the group serve afterwards for each pupil in the group to construct the plan of the island.

Marks, which enter into the final classification, are accorded to this topographical drawing.

32. *Graphical and Topographical Drawing.*—The graphic drawing is as follows:—

Graphic Drawing:—

(1) Sketches, freehand, and from sight, from mural drawings.
(2) Plans, elevations, and sections of agricultural buildings, with their interiors, to a given scale (from sketches).
(3) Various drawings of masonry, joinery, parts of machines, simple machines.
(4) Drawing of the topographical plan of which the survey has been made.
(5) Study of various questions, *e.g.*, surfaces and trace of a road, with all cuttings and embankments.
(6) Sketches of ruled surfaces applicable to machinery or other agricultural constructions.
(7) Various drawings executed according to the programme of vacation work.

In order to assist the students, autographic notes are distributed to them.

The students are divided into groups of ten for these drawings, and the drawing is done four days a week from 1·30 to 4 p.m.

The whole work is really as follows:—

25 attendances of	$2\frac{1}{4}$ hours	... ...	$56\frac{1}{4}$ hours.
50 „	$1\frac{1}{4}$ „	... ...	$62\frac{1}{2}$ „

That is a total of 75, with about 120 hours in all.

The topographical drawing will be referred to in the next section.

33. *Topography.*—Ordinary the pupils meet in the professor's room in groups of ten; where the reliefs, the wall maps, and the various instruments are kept.

The general outline is as follows:—

(1) *General topographical considerations. Explanation of the methods of the new cadastral survey.* Triangulation. The topographical polygon. Survey of details. The relief of the surface. Calculation of areas.

The relief of the Commune of Fontenay-aux Roses, and its environs, has been surveyed, constructed on a large scale—$\frac{1}{2000}$, and specially placed at the disposal of the professor for this teaching. A plan on the same scale, side by side with it, allows of a comparison by the students.

The relief, in addition to the forms of the plots, gives also the details of the cultivations, it has the triangulation shewn thereon, the topographical polygons, the equidistant level contours. These are also all shewn on the plan.

(2) *Description and use of various instruments. Geodetic circle, level with independent tube, water level, Goulier's collimator level, tacheometer.*—These instruments are manipulated in the presence of the students in groups of ten.

After explanations and descriptions autographic notes are distributed to the pupils.

(3) *Reference to and drawing of topographical plans.*—The pupils borrow for the execution of the topographical plans, a sketch of the triangulation, with examples of trigonometrical calculations; the co-ordinates of stations, levels, etc., etc.

(4) *Comparative cartography, the customary practice in cadastral documents.*—The students having already familiarised themselves with topographical drawing, are shewn various types of French and foreign plans, the professor briefly explaining them.

They thus obtain an idea of the old *cadastre* by extracts from the Atlas of Noisy-le-Roi and its cadastral original, and also of the new *cadastre*, by a brief analysis of the sheets of Neuilly plaisance, published as specimens by the extra-Parliamentary Commission of the *Cadastre*.

(5) *Exercises in the field.*—Manipulation and practice with the instruments; and their practical use. The pupils are divided into groups of about 13 or 14 each; and about three groups go out together under the professor, the "chief of works" and the "*répétiteur*." The groups work as follows:—

1st Group.—*Geodetic circle and tacheometer.* Each pupil measures an angle and a distance.
2nd Group.—*Level.* The pupils make a small level survey, *closing* on the initial point.
3rd Group.—*Collimator level, water level, and staff.* The pupils survey a profile and a contour, and compare with plan.

(6) *Practical Tests.*—Simple angle or altitude. Measuring operations are performed by the pupils, the accuracy being tested.

(7)

(7) *Vacation Work.*—During vacation the pupils make various topographical surveys and sketches, at their own choice.

The course is thoroughly practical, it will be seen, and it will be noticed that *the Government affords very special assistance* by having a special map and a special relief constructed on a large scale. The value of this is obvious, and it illustrates how *direct* is the regard for the Government departments for the improvement of the education of the people.

34. *Social Sciences.*—The agronomical course does not neglect the legal and quasi-legal knowledge necessary for the agriculturist or agricultural engineer. The courses embrace:—

(1) Rural registration and administrative right.
(2) Rural economy.
(3) Agricultural accountancy.
(4) Political economy.

The programmes of each of these will be given in detail.

35. *Rural Legislation and Administrative Right.*—The course consists of thirty lectures, and deals with the general conceptions of law and legislation, and then with their special applications in agriculture.

RURAL LEGISLATION AND ADMINISTRATIVE RIGHT.—PROGRAMME OF THE COURSE. (30 lectures.)

Introduction.—What is to be understood by law or legislation in general. What is rural legislation?

Division into three parts: (1) Laws which relate to things, and more especially to the soil. (2) Laws which have regard to persons. (3) The relation of the agriculturist to the administrative authorities in regard to the principal acts which rural exploitation involves.

Sources of rural legislation and of administrative law applied to agriculture.

"Recueils" which contain this legislation.

What is jurisprudence? Aim of the rural code. Its partial realisation.

I. *Rights concerning things, and especially the Soil.*

In what the right of property consists. What constitutes its elements. Who may be a proprietor? What things can be subject to the right of property.

Measures which the law allows the proprietor to take, in order to assure to himself the exclusive enjoyment of his right. Enclosures. Boundaries.

The utility of general boundaries.

The limits of the right of property relative to the right of user. In other terms, to the rules to which the proprietor should conform who desires to build, plant, and excavate on his property.

Constructions. Plantations. Excavations. Cases where the land contains a mine, or a quarry, or a spring of mineral water.

What are the limits of the right of property relatively to the right of enjoyment or of usufruct.

Advantages reserved to the lawful possessor. Unprofitable pasturage. Cultivation of the vine. Cultivation of tobacco.

The limits of the right of property relatively to the right of disposal. Of the clearing of timber.

Certain particular forms of the right of property. Joint possession or co-proprietorship. Forced joint-possession; roads, intermediate enclosures. Various cases of separation of the property in the surface and in the subsoil.

How property is acquired. Occupation. Accession. Succession. Gift. Prescription of furniture and personal property; theory of possession and of possessory actions. Conventions. Law.

What is to be understood by dismemberment of property. Concerning usufruct. How it is established. The rights and obligations. One who enjoys the usufruct. Of the "*nu-propriëtaire*" (owner who is not possessed of the usufruct of his property). Usufruct, how extinguished. Concerning usage and habitation.

Real servitudes or "*services fonciers.*" Servitude of transition in case of an enclosure. Servitudes established by the deed of man; in what they consist; how they arise; how they are extinguished.

Forest servitudes or forest customs. Their exercise in the forests of the State; communes and public establishments; particular cases.

II. *Personal Rights.*

Their different sources:—(1) Contracts. (2) Quasi-contracts. (3) Delinquencies. (4) Quasi-delinquencies. (5) Law.

I. *Contracts.*—General rules which govern the making of contracts. Effect of contracts. Extinction of obligations. Contract of sale. Special matters relating to its making, of its external mode, to its cancellation or annulling. Defects (rendering a sale null and void). Exchanges. Advantages accorded to the exchange of rural personal property.

Letting.—(1) Lease of a farm. Making the contract. Its effect. How the contract is extinguished. Long-term lease. Improvements made by the tenant. "*Cheptel*" (lease of cattle for half the profit) constituted by the lessor.

(2) "*Métayage.*"—Its nature. How it originates and terminates. Of the case where a "*cheptel*" has been joined to the "*métairie*" (land held on condition that the landlord shall receive a settled portion of the produce).

(3) Very long lease ("bail emphytéotique"). Its utility. Its making. Its effect.

(4) Covenant lease.

(5) "*Cheptel*" lease. Simple "*cheptel*"; moiety "*cheptel*"; "*cheptel*" of cows.

(6) Hire of labour. Workmen and domestics.

Freight

Freight Contracts.—How established and proved. Responsibility of the carrier. Obligations of the sender. Tariffs of railways: Legal tariffs, tariffs of application, special tariffs.

Company Contract—Ordinary companies. Companies of mutual agricultural credit. Local banks. Professional syndicates. Associations.

Contract as to deposits.

Assurance Contract.—Its utility. Difficulties met with in the constitution of certain agricultural assurances; the proper procedure. Mutual assurances, or at fixed premiums. Effect of this contract. How it is extinguished.

II. *Quasi-contracts.*—Management of affairs.

III. *Delinquencies.*—Penalties which are habitually permitted. Their satisfaction. Public and civil action. Misdemeanours of falsification of rural products. Falsification of commodities. Frauds in commerce, in manures, butters, and wines.

Misdemeanours of the chase. Forest misdemeanours.

IV. *Quasi-offences.*—Injurious acts. Responsibility for others. Accidents during work.

V. *Law.*—Obligations resulting from military demands. Preparation in times of peace for the mobilisation of horses and carriages; census, classification. Demand.

Means put by the Legislature at the disposal of the creditor, in order that he may secure payment.

Guarantees that he can take—(1) Against the dishonesty of the debtor; (2) Against his ill-will; (3) Against his insolvency. Personal security. Real security; ordinary pledge, "*warrant agricole*" privileges; legal, judiciary, and conventional mortgages. Reforms proposed relatively to the mortgage régime and agricultural credit.

Matters relating to the State of Persons.—Minority. Interdiction. The legal condition of a married woman. Prodigals and persons of weak intellect.

The Merchant. Commercial records. Special rules which govern commercial contracts. How they are applied to contracts entered into by agriculturists.

How Disputes concerning Private Interests are judged.—Organisation of judicial tribunals. Summary ideas as to procedure.

III. *Relation of the Agriculturist to the Administration, or, in other words, Administrative Right applied to Agriculture.*

Two principal divisions:—(1) Administrative organisation; (2) The functions of this organisation.

(I) *Administrative Organisation.*—In what administration consists.

The principal means of administration. Distinction between the general, local, or special interests.

(i) Administration of general interests. President of the Republic. Ministers. Council of State. Prefects. Sub-prefects. General secretaries. Mayors. Commissioners of police. Auxiliary agents: "*personnel, forestier, financier,*" etc.

Privileges conferred on prefects in police affairs. The chase. Rural and sanitary police.

(ii) Administration of local interests. Départements and communes. Centralisation and decentralisation.

System actually followed.

Of the département. Prefect. Conseil général.

Departmental Commission.

The arrondissement. Sub-prefect. Council of the arrondissement.

The Canton. Without special administrative representation. Commune. The Mayor considered, not so much as an agent of the central power, as a representative of the commune.

His privileges in municipal, rural, and sanitary police affairs. Explanation of the law of the 21st June, 1898. Agents of the rural police: Rural guards, special guards.

Administrative powers of the Mayor. Direction of the works, of the expenses. Preparation of the Budget.

Municipal Council. Nomination, its functions, its privileges. Communal domain. Communal works. Communal budget: Joint tenancy of property between several communes. Properties belonging to sections of the communes.

(iii) Administration of special interests. Public establishments: Agricultural consultative chambers; hospitals, etc. Establishments of public utility: various societies; professional syndicates.

(II) *Working of the administrative body* in respect of the execution of public works, to public ways, to the waters, to noxious establishments, to taxes.

(i) Public Works.—(1) Modes of execution: Administration, contrasting, concession. Co-operative tenders. (2) Damage caused by public works: Indemnities. Extraction of materials and temporary occupation. Telegraph lines. Competency of the Councils of prefecture.

Dispossession. Normal procedure. Exceptional procedure in cases of amicable transfer, of urgent works, of communal works, of works respecting either to the vicinal roads, or to the restoration of mountainous plots. Competency of the judicial tribunals and of the jury, especially as regards the determination of the indemnity. Appeal against abuse of power, to the Council of State. (3) Increase of value to private properties from the execution of public works. Direct or indirect increase of value.

(*a*) Direct increase of value. Syndical associations, compulsory, authorised, or free.

Compulsory association in matters of cleansing non-navigable water-courses, of draining of marshes, of damming up.

Authorised associations.—System adopted by the law of the 21st June, 1865, modified by the laws of the 20th August, 1881, 15th December, and 22nd December, 1888. Regulation of the public administration, dated 9th March, 1894.

Free associations. Mode of formation. Mode of administration. Means of action.

(*b*) Indirect increase of value. Law of the 30th September, 1807.

(ii)

(ii) Highways. Distinction between the highways and ordinary roads.

(1) Highways. National roads. *Routes départementales.* Their position, as public properties. Position of adjoining properties: alignment; demolition of edifices threatening ruin; obligations relative to the waters which flow from the road and as to the soil from the cleansing of drains; obligations relative to plantations.

Right of an adjoining proprietor: access, view, roof-drainings, household waters. Police regulations. Ordinances previous to 1789.

(2.) Ordinary roads. Vicinal roads. Rural roads. Urban roads.

Vicinal roads.—Their position in so far as public properties are concerned. Classification. Recognition or declaration of vicinality (condition of the roads of a parish). Opening, straightening, or enlargment of a vicinal road.

Division of vicinal roads into three classes.

Resources of vicinality: subsidies, "*centimes spéciaux*," payment in kind, industrial subsidies.

Road-agents. Condition of adjoining properties. Rights of drainage, view, and access.

Obligations: alignment, plantations, demolition of edifices threatening ruin.

Police regulations. Prefectoral decrees. Competency.

Rural roads.—As public properties. Recognised and unrecognised. Syndical associations. Position of adjoining properties. Police regulations. Prefectional and municipal decrees.

Forest roads.—Summary notions.

Urban roads.—Streets, from the standpoint of public property. Position of adjoining properties. Police regulations.

(3.) Waters.—Running waters, stagnant waters.

(*A.*) *Running waters.*—Springs, non-navigable water-courses, navigable water-courses, canals, and canalised rivers, rivers navigable for lumber.

Springs. To whom they belong. In what degree, and under what restrictions.

Non-navigable water-courses. Their legal condition.

Alluvions. Property in islands. Change of river-bed.

Fishing-rights. Water-rights. Cleansing.

Police of non-navigable water-courses.

Navigable water-courses. What do they comprehend? To whom they belong. Natural alluvions, artificial, imperfect. Water rights. Servitude of towage and towing-path. Canals and canalised rivers: special regulations.

Rivers navigable for lumber.

The position of hydraulic works, of irrigation, of fishing on the different water-courses.—

(i) Hydraulic works. Rules applicable to the works established on the navigable water-courses. Property. Conditions of working. Requisition of water for the supply of towns, or for irrigation.

Works established on the non navigable water-courses. Rights of the users. Extent of the police rights of administration. Indemnities.

(ii) Irrigation—canals. Constructed by a single proprietor. By a free or authorised syndical association. By a grantee. By the State.

(iii) *Fishing.*—To whom does the right belong? How is it exercised? What is understood by the police as to fishing? Authorised fishing appliances; seasons and hours during which fishing is permitted; size of fish which may be taken; establishment of fish-ladders. Competency.

(*B.*) *Stagnant waters.*—Suppression of noxious pools. Amelioration of damp and unhealthy localities; drainage; amelioration of marshes and waste lands belong to the communes (law of the 28th July, 1860).

(i) Unhygienic workshops. Classification. Authorisation. Remedy. Steam-engines.

(ii) Rural taxes. Direct taxes. Indirect taxes. Direct taxes; land-tax, personal property, doors and windows, licenses, horses and carriages, dogs.

Indirect taxes; sugars, drinks, customs-duties, stamp-duties, and registration.

Appendix.—What recourse individuals have against administrative acts.

Administrative tribunals. Procedure.

This course is, no doubt, necessary and practical, and a similar course is as really requisite for those who propose to deal with similar matters here.

36. *Complementary "Conferences."*—Besides the above there is a course of instruction concerning the following, viz.:—

(i) The judiciary tribunals, viz., (1) The civil jurisdiction; (2) The criminal jurisdiction; (3) The Court of Cassation.

(ii) The administrative jurisdiction.

(iii) Taxes, and their divisions.

(iv) Military law, recruiting, exemption, military tax, etc.

(v) Agricultural syndicates.

(vi) Agricultural credit, its history, rôle, and organisation, and the advantage it confers.

(vii) French colonies, their development; colonial banks, etc.

These are developed in considerable detail which, however, is not given. 37.

37. *Course in Rural Economy.*—This course of forty lectures has for its object the development of an intelligent appreciation of the economic relations of agricultural enterprises. The course is as follows :—

RURAL ECONOMY. PROGRAMME OF THE COURSE (40 Lectures).

Introduction.—Rural economy : its object, aim, and method.

I. *Special Rural Economy.*

Organisation of Agricultural Enterprises.—Special characteristics of agricultural industry, its various productions. Circumstances which determine the choice as to pastoral or cultural operations, and of their association with each other. Influence of climate, soil, economic means, and markets. Attempts at classification of systems of cultivation.

Agricultural production.—Definition, evaluation, production corresponding to different agricultural operations, with different systems of cultivation in different countries. Statistics.

The agents of agricultural production, their rôle, and remuneration.—The State : its privileges and their limits; its intervention in agricultural matters. General, Departmental, and Communal duties. Taxes on the property on cultivation and agriculturists. Relation between the duty and the amount of production, between the duty and the landed revenue.

Workmen.—Various categories of agricultural workmen, organisation of agricultural work. Work required in different agricultural operations and different systems of culture. Salaries: their relation to the amount of production, and landed revenue.

Auxiliary agents of cultivation.—Auxiliary services : administration, assurances, maintenance, and renewal of stock and cattle ; values which they represent ; their relation to production. Purchases of raw material, manure, fodder, etc , for the cattle, seeds, etc. ; their importance as regards agricultural operations and systems of culture, their relation to production.

The agriculturist.—Organisation and direction of agricultural enterprise. Exploitation, capital, and its division ; evaluation, their importance and rôle in the various systems of culture. Profit, its variability, its estimation, and its appreciation ; its relation to the involved capital, to the production. The profit per unit of area, per unit of capital, and per unit of production.

The proprietor.—Soil, buildings, and "*cheptels.*" Evaluation of landed capital. Administration of rural properties ; maintenance, management. The yearly income ; its importance in the various systems of cultivation, its relation with the landed capital, with the tax, with production, with salaries, with the profit, and with the cost of agricultural products.

Control of agricultural operations.—To bring into evidence the results ; book-keeping ; balance-sheet.

II. *General Rural Economy.*

Study of the principal questions of rural economy—History of agriculture and of rural economy—Sources : general, special, and local documents. Transformations and progress of the methods of working of the soil and of the condition of the cultivators.

The State.—Agricultural teaching in France and in foreign lands. Encouragement to agriculture, directly by the State or by the medium of agricultural associations ; their effects and results. Services of studs, of forests, of agricultural hydraulics. Rural police. Public works of interest to agriculture. Organisation and budget of the Minister of Agriculture in France. Contributions of agriculture and other professions at the public expense compared. Organisation of the general agricultural services of the colonies. International comparisons.

Landed property—Theory of property and annual income.—History of landed property. Property under the ancient régime, under the Revolution, at the present time. Agrarian régime of France, of the colonies (agricultural colonisation, concessions, and sales of lands, etc.), foreign countries.

Property and the collectivist doctrine.

Property and the title to property.—Register of the survey of lands (the Cadastre), landed registers, immatriculation. Systems in force in France, in the colonies, in foreign countries.

Working of uncultivated lands and amelioration of cultivated lands.—Clearings, amelioration, irrigations, construction, works of defence against the sea and rivers, works of art, reafforestation, improvements, etc. Private and collective enterprises. History of the most remarkable works in cultivation of lands in France, in the colonies, and in foreign countries.

Ground-rent.—Its theory ; its variations, compared with the accumulation of landed property, now and formerly ; its importance as an index of the variations of the economic situation of agricultural industry ; its elevation in various centres, its relation with the yield of the principal cultures, with the production.

Estimation of landed property :—(*a*) in body of estate, (*b*) by parcels, land, trees, vineyards, gardens, waste lands, buildings, "*cheptels,*" usufructs, properties without the usufruct, servitudes, etc. Estimation of the crops, of the stock, of cattle, of straw and fodder, of manures, etc. etc. Surveys.

Constitution of property and of cultivation..—Distribution of property according to the kind of proprietor. Division and parcelling out, territorial reunions. Landed companies. Measures taken in different countries to facilitate the access of property to workmen and to small cultivators. Family property. Interior colonisation. International comparisons.

Methods of working.—Direct cultivation, farming, métayage. Long lease and perpetual lease. Contracts of renting peculiar to certain countries. Relations between proprietors and cultivators. Landed ameliorations and the position of the cultivator under various modes of exploitation.

Property and mortgage.—Mortgage, its advantages, its inconveniences. Institutions of "*crédit foncier.*" Mortgaged title-deeds, letters of security. Mortgage statistics.

Working

Working Capital.

Detailed study of the idea of capital.—Values envolved in an exploitation, realisable values. Reserves, provisions and amortizations. Establishing of inventories. Classification : fixed and circulating capitals. The exploiting capital and its distribution among the various systems of cultivation.

Agricultural machines.—Their development and results. Machines and hand labour. Determination of the necessary stock in various systems of cultivation.

Cattle.—Draught cattle and stock cattle. Rôle of cattle as medium of internal transformations and production. Selection of species, breeds, and operations. Economy of herds, breeding, reform, remounting. Cattle under various systems of cultivation and in various countries.

Available capital.—Sunken and liquid capital. Organisation of the service of the bank in the agricultural enterprises. Payments and recoveries. Credit and banks. Current accounts. Proportion of available capital to the annual expenses. Fluctuation of species corresponding to various systems of. cultivation. Examples.

Labour.—History of the rural classes. Urban populations, rural populations. Emigration from the country, displacements of agricultural workmen, stoppages. Workmens' syndicates. Variations of wages locally, and at different times. Monthly, annual, periodic variations. Material and moral position of the working classes. Workmen's budgets, savings, their utilisation. Rural festivals. Mutual help societies, assurances against accidents, workmen's pensions. Mendicity and vagrancy. Agricultural workmen in the colonies ; native and European workmen. Agricultural workmen in foreign countries.

Transport and freight charges.—Internal transport by road, railway, canals, sea. Value and cost of transport, régimes of competition and monopoly. Tariff of railway companies, importance of their application, tariff in regard to the principal agricultural products and materials of service in agriculture. Maritime freight, its diminution, its influence on the commerce of agricultural products.

Commerce of Agricultural Products.—Fairs and Markets.

Commercial exchanges.—Free and limited markets. Speculation and its effects. Co-operative organisation for sales ; granaries, co-operative stocks, etc. Temporary admissions, importations. Markets of the small towns. Central markets of Paris. Provincial markets.

The depreciation of silver and of exchange.—Quotation of precious metals ; monetary régimes of various countries, mechanism of exchange, and current exchanges. Influence of the course of exchanges on importations and exportations, on the price of agricultural products. Economic position of countries financially discredited.

History of our customs régime.—Régimes of protection, of commercial freedom, of commercial treaties. Reform of 1892. Interpretation of the tabulated figures of the custom-house. General and special commerce. Customs régime of the colonies, of foreign countries.

Special study of the trade in wheat, wines, cattle, wools, sugar, alcohol, etc.

Agricultural Productions.

Productions of vegetable origin.—Cereals, food products, beet-root sugar, textiles, oils, fodders, products of kitchen garden and floral cultivations, timber, wines, colonial cultures. Statistics, etc.

Production of animal origin.—Special production of bovine, ovine, porcine species, and of animals belonging to the poultry-yard. Statistics.

Principal centres of production. Rôle of capital and of work in each of these productions. Variation of yields and of prices. Over productive countries and countries deficient in production. Special markets for each of the agricultural products. Original marks. Commercial usages. Internal competition, fraud, adulteration, unfair competition. Foreign competition, variations of the rights of customs. International comparisons. Productions of national and foreign agriculture compared.

Agricultural industries.—Dairies, butter factories, cheese factories, sugar works, distilleries, manufactory of feculas, milling, baking, oil manufactory, etc. Organisation and economical working, services rendered to agriculture.

Association and Co-operation.

Agricultural associations.—Agricultural societies and committees, their activity and results.

Agricultural syndicates, their rapid development, purchase, sale, information, defence of agricultural interests. *Mutual agricultural credit.* Local and regional banks, agricultural warrants. *Co-operative societies of production and consumption* . bakeries, butchers, butter factories, cheese factories, etc. *Assurances* against fire, hail, accidents, the mortality of cattle ; rôle of mutuality.

The systems of cultivation.—Principal systems characteristic of French agriculture ; organisation and results from the point of view of the proprietors, of cultivators, of workmen and of the local and general wealth. Studies supported by monographs on rural exploitation.

Agricultural geography.—France, colonies, foreign countries.

The agricultural crisis.—Its causes, its measure, its effects, means of weakening it.

Agricultural book-keeping.—Account and discussion of the methods.

It is justly remarked that the programme of the course in rural economy is much too vast to be treated with any completeness. Consequently, after having given a summary explanation of the essential conditions to be taken account of in agricultural industry, the professor developes only certain questions of general rural economy, modifying his teaching from year to year according to circumstances.

38. *Course in agricultural accountancy.*—This course involves only six *conférences.* The course is one in accountancy rather than mere book-keeping, its object being rational rather than mere teaching how to open a set of books.

AGRICULTURAL BOOK-KEEPING—PROGRAMME OF THE COURSE. (6 Lectures.)

Distinction between book-keeping and accountancy properly so-called, or rational practice (in Italian, *raggioneria*).

Keeping of books.—Definition of the balance of accounts, and of double entry. Register in which is entered the work of field hands, of animals, and mechanical motors, etc. Register of consumption. Cash-book and agenda. Goods in stock.

Accountancy.—Accurate estimation of the day's work of the motors, the consumption, etc.

Keeping of the books.—Day-book and grouping of the auxiliary registers. Ledger and grouping of the accounts of the day-book. Closing of accounts at the end of the year.

Accountancy.—Time for the closure of accounts. Accurate estimate of expenses of management in agricultural exploitation. Estimation of manure produced, according to its value as fertilising matter, the weight and cubature being merely the means of calculation and of division. Respective duration of manures covered before or after winter. Influence of the time of covering. Influence of the value of manures on the losses and profits of exploitation.

Book-keeping.—Distribution per hectare of the annual expenses of the farm, including manuring, taxes, assurances, repairing, and wear and tear of stock, of tools, expenses of maintenance of real estate and general expenses. Profit and loss accounts.

Accountancy.—Importance of "profit and loss accounts" stating only the net result of each of the speculations of the farm, following the preliminary distribution of the annual expenses.

39. *Political economy.*—The course in political economy is more general than the preceding. It is outlined as follows:—

POLITICAL ECONOMY—PROGRAMME OF THE COURSE. (20 Lectures.)

Introduction.

History of the economic doctrines. Antiquity. Mercantilism. Adam Smith and his direct disciples. Ricardo and Malthus. The liberal school and its development in France. The historic school and its development in Germany. The socialists schools. The school of Le Play. The co-operative school.

I. *Production.*

(1) *Generalities concerning production.*—Importance of production in economic and social life. Is this importance destined to diminish? Stuart Mill's theory of the stationary state. The intensity of production in new countries.

(2) Over-production. Is general over-production possible? The theory of markets. Partial over-production. Crisis from over-production. Their frequency and gravity in contemporaneous societies.

II. *Labour.*

(1) Division of labour. Constant increase of the extent of the division. The economy of the family, of the city, national economy, international economy. Advantages of and reasons for the division of labour. Dangers of immoderate division of labour.

(2) Liberty of labour. Slavery. Servitude. Corporation. Modern regulation of labour. The labour of women, of children, of adults. Night-work. Discussions apropos of these regulations. The liberal thesis, and the interventionist doctrines.

(3) Unions and associations of workmen. Strikes. Syndicates. Trades unions. Workmen's associations in America. Consequences of unions and of associations from the point of view of the productivity of labour.

(4) The different methods of remunerating labour. Participation in profits. The co-operation in production. Fixed wages. Piece-work. Various premiums which may be added to wages. The movable scale of wages. Importance of these from the point of view of the productivity of work.

III. *Capital.*

(1) Various definitions of capital. Differences of conception, according as it is viewed from a private or social point of view. The rôle of capital in the *ensemble* of the work of production.

(2) The formation of capital. Savings. Invention.

(3) Fixed and circulating capital. Of the necessity of maintaining a suitable proportion between them. Tendencies of modern communities to multiply in an excessive degree the fixed in proportion to the circulating capital. Reasons of this tendency. Its dangers. Crises come about by the fact of rupture of equilibrium between the fixed and circulating capital.

IV. *Enterprise.*

(1) Distinction between private and public enterprises. Their comparison from the point of view of productivity. Public or private enterprise in the exploitation of railways. English, French, and German railways. Line constructions. Co-efficients of exploitation.

(2) The distinction between enterprises under a *régime* of free competition and monopolies. The different kinds of monopolies. Monopolies by law. Actual monopolies. Their various causes. Monopolies by concentration. "Trusts" and "Pools" in America. "Cartells" in Germany. The "cartell" in alcohol. The "cartell" in sugar.

(3) Classification of great and small undertakings. Concentration in industry. History of this concentration. Probability of arrest in the path of concentration. Causes of this stoppage. Commercial concentration. The great warehouses. The question of licenses.

Concentration in agriculture. Why, in agriculture, is concentration not so conspicuous as it is in industry or commerce.

Circulation.

I.—*Generalities concerning Circulation.*

The theory of value and particularly of exchange value. The law of supply and demand.

II. *Money.*

(1) Its economic rôle. The services which money may render. Diversities of the objects employed in the place of money in primitive societies. Coinage and its utility. The theory of coinage compensation. Paper-money. What is to be understood by paper-money and by "*monnaie de papier.*" Abuses in the use of paper-money. The "Assignats." Countries with damaged finances. Description of the crises resulting from the abuse of paper-money.

(2) The rôle of the State in monetary matters outside the question of bimetallism and monometallism. History of abuses in monetary affairs. Government guilty of debasing coinage. Disappearance of these abuses. Necessity for modern States interesting themselves in minting and regulating the legal tender of money.

(3) Bimetallism and monometallism. The monometallist thesis and the arguments of its defenders. Bimetallism and its partisans. Monetary contraction and its dangers. Bimetallism as a means of combatting the agricultural crisis. The history of bimetallism and of monometallism in France. Bimetallism. Bimetallism until 1865. The situation in 1865. The Latin Union. Its history from the depreciation of the value of silver. The interdiction of the coinage of 5 fr. pieces. Monometallism in England. Monometallism in Germany. Its introduction after 1871. Monetary history of the United States. Gold monometallism in Japan, in the Indies, and in Russia.

III. *Credit.*

(1) Definition. Its proper economic role. How at certain times the power of credit has been exaggerated. Law's system.

(2) Deposit and discount banks. Their discount operations. The rate of discount. Variations in the rate of discount. Causes and consequences of these variations. Bills of exchange and other commercial effects. Cheques and the changing of cheques. Exchange. International exchange.

(3) Banks of issue. The bank-note. Distinctive characters of bills to order and cheques. The legal currency and forced currency. Circumstances in which they have been established in France. Question of the liberty of issue of the bank-note. The system of freedom. The system of monopoly. The system of a State Bank. Scottish Banks. American Banks. The Bank of England. The Bank of France. The privilege of the Bank of France. Its last renewal. The conditions of the renewal of the privilege.

(4) Special forms of credit. The public credit. State loans. Their history and their various forms in France. Amortizations. Comparison between the Amortization by the State and by private societies. Conversion. Conditions of their success. Popular credit. Its development in France and in other countries. The Credit foncier. Its economic and agricultural utility. Its organisation in France. Agricultural credit. Its economic rôle. Its development, specially in Germany and in Italy. The various types of agricultural credit banks. The development of agricultural credit in France.

IV. *International Commerce.*

(1) Importance of international commerce. Comparison between international and national commerce from the point of view of the consequence of social wealth. Different conceptions concerning the economic rôle of international commerce. Mercantilists' doctrines concerning the balance of commerce. Exaggerated importance given, in certain reactionary doctrines against mercantilism, to the advantages of importation from the point of view of the general increase of wealth.

(2) Free-trade and Protection. The freetrader's thesis. Various justifications of protectionist measures. History of free-trade and protection, particularly in France and in England. Reference for the detail of the history of the customs tariffs in France, to the course of rural economy.

(3) Some indications concerning the customs legislation: minimum and maximum tariff. The specific tariff and the tariff *ad valorem.* Temporary admissions and drawbacks. The question of the temporary admission of wheat. Protection without duty right. Bonuses: the mercantile navy. Silk culture. Flax.

Distribution.

I. *Inherited Property.*

(1) Analysis of the rights of property and succession. Historic evolution of one and the other.

(2) The various justificative theories of property and inheritance. The justification of property by the idea of work, by that of occupation; by that of social utility.

(3) Criticisms against property and against inheritance. Criticisms directed specially against property and more particularly against landed property. Criticisms against inheritance and particularly against the organisation of succession *ab intestat.*

(4) Various systems proposed as capable of being substituted for the *régime* of individual property. Communism under a form of authority and under a form of liberty. Collectivism. Agrarian collectivism. Criticism of collectivism.

IV.

IV. *Co-partnerships.*

(1) Landed proprietors. The rent-theory of Ricardo. Reference to the course of rural economy. The parcelling out of land.

(2) The capitalists. Interest. The justification of interest. Diminution of the rate of interest. Causes of this. Permanent or temporary character of these causes of diminution. Consequences of the fall of the rate of interest.

(3) The profit of contractors. Its justification. Causes of increase or diminution in contractors' profits.

(4) Wages. History of the variations in the rates of wages. Theories on the rate of wages. The wages fund. The law "*d'airain.*" The theory of wages determined by the productivity of work. Means of augmenting wages. Great public works. Measures against the competition of foreign workmen. The legal minimum wage. Legal protection of wages. The truck system. The sweating system. The workmen's assurances. Accidents. Pension.

CONSUMPTION.

I. *Public Consumption.*

(1) Taxes from the point of view of fiscal organisation. The budgets. Their organisation. Their history in France.

(2) Taxes from the point of view of their incidence. The real tax and the personal tax. Income tax. Progressivity, etc., of the tax. The tax from the point of view of its charge on the various classes of productors. The rôle of agriculture in the tax.

II. *Private Consumption.*

(1) The population. The facts. History of the population in France. Actual situation. Mortality and natality. Comparisons with foreign countries. Proposed remedies to meet the decline in the population.

(2) Luxury and its economic function. Saving and its economic function. Means of encouraging thrift. Savings banks. Life assurances against disease, against old age. Mutuality. Public assistance. Its organisation in France and in several foreign countries.

40. *Conclusion.*—The teaching of agronomy itself will form the subject of the next chapter. It will be seen from the above that the professional teaching proper is founded upon a thoroughly scientific basis of the highest character. Teaching on the same plane is not available as yet in Australia, nor in the United Kingdom. Nor could those who possess the qualifications to teach succeed, unless students came from the secondary schools altogether better prepared. This is obvious when one reviews the knowledge required for candidates admitted to the Agronomic Institute.

The only place where teaching in any way approaches that of the Agronomic Institute is the University, and it has neither the equipment nor staff to give similar teaching, though certain parts of the course could be taught if students came equally well prepared as they do in Europe.

The points to which special attention is drawn are:—

(1) The European conditions admit of the professional staff doing a larger amount of purely research work, hence the value of the teaching is higher.

(2) The students enter the Agronomic Institute thoroughly prepared to benefit by its lecture courses.

(3) The courses are given by eminent specialists, who are, without exception, important contributors to the progress of knowledge.

(4) The subdivision of subjects is more complete than here or in the United Kingdom.

CHAPTER XLV.

CHAPTER XLV.

The "Institut National Agronomique" of France.

AGRONOMY.

[G. H. KNIBBS.]

1. *Introduction.*—In the preceding chapter, the conditions of admission to the French National Agronomic Institute and the scheme of lectures on the fundamental sciences on which Agronomy is based, have been fully outlined. The splendid thoroughness and scientific value of the course will be obvious to every competent judge. It now remains to outline the course in Agronomy itself.

2. *Outline of the Course in Agronomy.*—The course in Agronomy embraces the following subjects:—

(i) *Agriculture*, 1st year, general; 2nd year, special. This embraces practical exercises, a reference to which will be found under the head of "*Conférences*" in Applied Agriculture.
(ii) *Zootechnics;* general and special, and practical exercises therein. Practical agriculture.
(iii) *Agricultural Machinery and Rural Construction;* with practical exercises therein.
(iv) *Agricultural Technology.*
(v) *Forestry; and the Economics of Forestry.*
(vi) *Viticulture*, with practical applications.
(vii) *Colonial Agriculture*; and its characteristics.
(viii) *Comparative Agriculture;* a study in French and foreign agriculture.
(ix) *Arboriculture.*
(x) *Apiculture*, *Pisciculture*, etc.
(xi) *Hippology;* the breeding and care of the horse.

When account is taken of the fact that the teaching is illustrated by general excursions and visits to agronomical stations, and to various industrial works having a more or less direct relation with materials required in agriculture, it will be seen that on the practical side the thoroughness and excellence is no less conspicuous than it is on the theoretical.

3. *Special Equipments.*—In connection with the Agronomic Institute, there are several stations and laboratories to which reference should be made, viz., the following:—

(1) Seed-testing station.
(2) Station for the testing of machinery.
(3) Laboratory for the study of Fermentation.
(4) Station for Vegetable Pathology.
(5) Entomological Station.
(6) Viticultural and Œnological Laboratory.
(7) Experimental Station for Agricultural Hydraulics.

It ought to be mentioned, that only pupils in their *Third Year* are accepted at these Laboratories, and their services are utilised as assistants. The stations are independently maintained, and should not be confounded with the Institute itself. Nevertheless, they constitute an integral factor in the Agricultural Education which is provided by the National Institute, or which is obtained immediately under its ægis.

4. *The Course in Agriculture.*—The course in General Agriculture consists, in the first year, of 26 lectures, and that in Special Agriculture (in the second year) of 20 lectures. The detailed programme is as follows:—

AGRICULTURE.

First Year: GENERAL AGRICULTURE.

(26 Lectures.)

Introduction.—Object, character, extent and limits of the course in agriculture. Its place in the scheme of instruction in the Agronomic Institute.
Value of the products of the large forms of cultivation; economic consequences of even the least progress.
Scientific and practical character of modern agriculture. Doctrine of clear profit. Definition of agriculture. Analogies and differences among the industries properly so-called. Division of the course.—

I. The natural agents of vegetable production: (1) The plant; (2) the climate; (3) arable land.
II. The processes of cultivation.

I.

I. *The natural agents of Vegetable production.*

(I) *The Plant*—

Seed and varieties. Significance of seed in vegetable production. Economic importance. Classification.

Preservation. Losses of substance; their importance; how to reduce them to a minimum?

Preservation of dry seeds: (1) in silos; (2) in granaries.

Preservation of moist seeds: (1) in cellars; (2) under sheds; (3) in the open air.

Germination. Capricious germination of the seeds of weeds, and also of the seeds of several economic plants; *old* and *fresh* seed; practical consequences. Germinal energy. Longevity of certain seeds.

Farm tests of germination. Influence of various substances with which the seeds may be in contact: Sulphate of copper, manure, etc. "*Pralinage.*" Germinators and substances stimulating germination.

Selection of seeds. Characters of seeds of good quality; insufficiency of mere morphological and organoleptic characters. Adulteration. Purchase with guaranties. Seed-testing stations.

Selection of varieties. Criticism of the ordinary methods of appreciation. Farm tests of varieties.

The renewal of seeds.

Methods of reproduction and improvement of the plants of "grande culture" (large farming). Great progress to be realised. Why phytotechnics are less advanced than zootechnics, and "*grande culture*" less advanced than horticulture and viticulture.

Selection. Crossing. Practice of these operations.

Experimental fields.

Principal improved varieties for "*grande culture*"; extension in surface and in depth; parallel development of the aerial system; practical consequences.

Composition of the plant in different stages of development and its physiological exigencies; practical deductions.

(II) *Climate*—

General climate of France; its essential characteristics; principal cultures.

Circumstances which modify the general climate of any region; local climates; their importance from an agricultural point of view.

(III) *Arable land*—

Soil. Conditions which should be fulfilled from a physical, chemical, and physiological point of view in order that satisfactory growth may be attained.

Sub-soil. Its properties compared with those of the soil. Influence of the nature and the depth of the sub-soil on the success of cultures.

Impermeable Stratum. Minimum depth of the water-sheet according to the culture, soil, and climate.

Description of arable land. Agricultural features of "*terres extrêmes*" as regards mineralogical composition; siliceous, calcareous, argillaceous, humiferous lands.

Classification of lands. Agrological, economical, and mixed classification.

Classification of ameliorations; their relative importance.

Physical amelioration—

(1) Calcareous amelioration; characteristics of the lands which need it. Limes and marls; composition, relative efficacy; quantities to be employed; net cost of work per foot.

Liming and marling.

Calcareous amelioration other than with lime and marl.

(2.) Amelioration by supply of humus.

Chemical or Fertiliser—Amelioration.

Purchase of commercial manures; ameliorations which should precede their use.

(*a*) *Mineral manures*—

(1) Phosphate manures. Phosphate manures that must be selected in the present conditions of the market, taking account of the soils and the cultures. Net cost per kilogramme. The method of using and quantity necessary in the case of phosphates. Periods at which they should be used. Spreading, covering. Mixed manures.

(2) Potash manures.

(3) Nitrogenous manures.

(4) Plaster. Sulphate of iron. Pyritous waste.

(*b*) *Organic manures*—

(1) Farm manures. Calculation of the quantity produced in an exploitation. Composition. Crop; conservation. Earths and cultures for which farm manure is especially suitable. Quantities to be employed. Transport, spreading, covering. Liquid manure. Folding. Manures purchased abroad. Offal, Flemish manure.

(2) Organic manures of commerce.

(3) Vegetable manures Classification. Green manures. History. Green manures in rich and poor earths. Plants to be cultivated as green manures, according to the climate and the nature of the soil. Cultivation of manure-plants and covering. Criticism, from an economical standpoint of the practice of green manures.

Vegetable manures acquired elsewhere.

Composts.

Establishment on the farm of a field of manure analysers.

Physiological amelioration.

Ameliorations drawn from exploitation.

Ameliorations drawn from commerce: nitragin, alinite.

II. *The Operations of Cultivation.*

Clearing—

(1) Clearing of lands covered by herbaceous vegetation. Healthy meadows, conditions of success; moist meadows. Special characteristics of peaty meadows; errors to be avoided as regards improving these meadows. Rimpau method; Dutch method. Weeding and burning the weeds.

(2) Clearing of lands covered by a semi-ligneous vegetation.

(3) Clearing of lands covered by a woody vegetation. Removal of rocks. Planting of edges.

Cultural

Cultural operations preceding sowing—

Ploughing. Object. Conditions of good ploughing: depth; breadth, inclination, direction of the furrows. Form of the ploughing.

Importance of deep ploughing. Conditions of success, results obtained. Period of ploughing, number, its execution. Quasi-ploughing. Harrowing. Rolling. Fallow lands. Noxious fields and meadows: origin, biology.

Methods of destruction: order of succession of crops; mechanical and chemical operations.

Sowing—

Condition of soil which ought to be satisfied at the time of sowing. Period of sowing. Seeds: Preparation to which they should be subjected. Quantity per hectare. Distribution in surface and in depth. Comparison between the different methods of distributing the seed. Seed-plot in the nursery. Transplantation.

Cultural operations which should follow the sowing—Explanation. Harrowing, rolling, digging, etc.

Harvesting and preservation of the crops—Fodder plants. Time of harvest. Cutting with hand instruments, and machines; comparison between the two. Hay-making; ordinary method, moyettes, drying. Haylofts, haystacks, binding, sale.

Brown hay.

Ensilage, sweet and sour ensilage. Pit silos, silos above ground. Open silos. Use of ensilage. Preservation of roots. Cereals. Harvest time. Cutting with hand and by machine: Comparison between the two. Care necessary after cutting. Threshing, cleaning, warehousing and sale of grain.

Second Year: SPECIAL AGRICULTURE.

(20 Lectures.)

Object and extent of the course of special agriculture. Classification of the plants studied.

(I) *Industrial Plants and Weeds.*

Historical sketch. Influence of the production of plants of this group on the progress of modern agriculture. Economic importance.

Beet-roots: Classification. Origin, geographical distribution. Morphology and physiology.

Industrial beets: Cultivated areas in France and in the principal countries producing beet sugars; characteristics of roots of good quality. French and foreign varieties.

Selection. General method. By cuttings and graftings. Production of seed for sale.

Soil. Place of beet in rotation of crops. Preliminary dressing.

Manures. Sowing, and subsequent care.

Harvest, yields. Preservation. Delivery at manufactory.

Improvements of which beet-growing is susceptible. *Bibliography.* (Each culture is studied in the manner outlined for beet-root.)

Fodder beets. Coffee, chicory. Swedish turnips, turnips, carrots, parsnip. Fodder cabbages.

Potatoes. Jerusalem artichokes.

Oleaginous plants: colza, rape-seed, mustard, poppy, sunflower, etc.

Textile plants: hemp, flax.

Tobacco. Hop.

(II) *Alimentary Plants.*

Economic importance.

Cereals. Wheat, rye, méteil (mixture of the two), barley, oats, maize, millet, sorghum. Buckwheat. Position created by foreign competition. Progress to be realised.

Leguminosæ.—Peas, beans, lentils, broad beans.

(III) *Fodder plants.*

Economic importance of fodder production. History. Great progress possible. Classification of plants suitable as fodder.

Leguminosæ.

(1) Perennial species: cultivated lucerne, sainfoin, broom, vetch, Pannonia, clover, hybrid clover, white clover, *lotiers.*

(2) Annual or biennial species: *trèfle des pres*, sweet trefoil, *minette*, kidney-vetch, red clover, *sulla.* Peas, vetch, lupin, *serradella*, lentil.

Gramineæ.

(1) Perennial sorts: the best gramineous plants for good soils; for mediocre soils; approximate period, suitability as regards mowing or pasturing; resistance to dryness and humidity. Yield and nutritive value. Rye-grass, *fléole*, oat-grass, *dactyla*, yellow oats, various straw-plants, etc., etc.

(2) Annual or biennial species: rye, barley, maize, sorghum, millet, etc., etc.

Minor gramineous and leguminous meadows.

Classification.

(1) Temporary meadows and pastures; comparison with artificial and permanent meadows.

Creation and exploitation: their place in the rotation of crops; preparation of soil dressing; deep and surface dressing. Sowing: Spontaneous grassing, grass flowers. Seed and its definitive composition. Principles which should guide the agriculturist in the selection and mixing of various species. Commercial formulæ.

Sowing in virgin soil, in a nursery. Subsequent attention necessary. Harvest and yields. Clearance. Goetz meadows.

(2) Permanent meadows and pastures. Creation. Subsequent care, exploitation. Clearings of old meadows, conditions of success. Special care necessary in pastures.

Fodder species of various families.

Knapweed, milfoil, *Persicaire* or Sakhalin, white mustard, colza, rape-seed, etc., etc.

Succession of cultures of short period, so as to obtain green fodder during the whole year, and to guard against insufficiency of meadow production.

Rotation

Rotation of crops.

Inconveniences involved in the uninterrupted culture of one and the same species in one and the same area. "*Sympathy*" and "antipathy" between different cultures. Definition of terms, rotation, system of culture, etc., etc.

Conditions of a rational rotation. Selection of crops to be cultivated, order of their succession. Duration of the rotation. Criticism of the principal schemes of rotation.

Free rotation.

In the above the theoretical knowledge, derived in the study of the fundamental sciences of agronomy is seen in its application, and the instruction how, illustrating the application of the scientific knowledge, has a value and significance to the scientifically prepared student which ordinarily it would be deficient in.

5. *Applied agriculture.*—In addition to the preceding course in agriculture, there are what are called Conférences in applied agriculture. These number about 20, with actual demonstration on the plot, and embrace the various operations in the different seasons.

The actual work covers the following range:—

(1) Examinations of soil and subsoil;
(2) Care of animals, and their management generally;
(3) Various farm and agricultural operations;
(4) Mode of working;
(5) Surface preparations of soil;
(6) Manures employed in "*grande culture*";
(7) Study of commercial samples of grain;
(8) Preparation of seed;
(9) Sowing, wheat, oats, barley, etc.; beets, trefoil, lucerne, potatoes, etc, etc.;
(10) Subsequent treatment;
(11) Practical study of the growing cereals, etc.;
(12) Study of the gramineous and leguminous meadows in flower;
(13) Study of the cereals in the ear;
(14) Methods of harvesting cereals;
(15) Handling of the harvest including preservation in granaries, drying, extermination of insects, and storage;
(16) Autumn harvesting. Beets, potatoes, etc.; cellarage, silos, etc..

Excursions are made to farms and the students are familiarised with as many types of cultivation as possible. They see the operation of large distilleries, of the factories for beet-sugar, of the most important dairies, the scheme of seed selection and testing.

The course is very thorough.

6. *Course in Zootechnics.*—The course in Zootechnics is a long one, there being 50 lectures in the subject. The programme is as follows:—

ZOOTECHNICS—PROGRAMME OF THE COURSE. (50 Lectures.)

Introduction.—Place of animal production in agriculture. Interrelations between animal and vegetable productions. Domestic animals from the point of view of means for the transformation of aliments. Products obtained.

Science and animal production. Historical references. Zootechnics. Biological and economic problems raised by this applied science. Doctrines regarding zootechnical perfection. Necessity for the financial control of zootechnic operations. Plan of the course.

FIRST PART.—GENERAL ZOOTECHNICS.

(I) *Alimentation.*

Study of nutrition—

Chemical composition of the body of animals. Constituent substances of the organism; nutritive principles; exchanges between the organism and its environment; material and dynamical nutritive exchanges. Methods of measure of the nutritive exchanges. The organism and balance of receipts and expenses. Fundamental data resulting from the use of these methods. Modification of the living weight of animals, and the nutritive exchanges.

Organic nutrition.

Nutritive exchanges in animals fed. Work of digestion; its chief importance for the appreciation of the nutritive value of aliments. Gross and net nutritive value of various aliments.

Nutritive exchanges in animals with care. Value of the various groups of nitrogenous nutritive principles, fats and hydrocarbons for the formation and the fixation of fatty matters in the organism. The value of the various groups of nitrogenous, fatty and hydrocarbon nutritive principles in respect of the production of muscular and mechanical work. Mechanical yield of the various nutritive principles and aliments. Possible substitutions between the various groups of nutritive principles. Isodynamic and isoglucosic weight. Limits of substitution. Nitrogenous nutrition of the organism and the conception of the nutritive relation.

Inorganic nutrition.

Water. Mineral matters. Phosphoric acid. Lime, sea-salt.

Study of aliments—

Chemical composition of aliments. Raw nutritive principles. Digestible nutritive principles. Nitrogenous matters, proteids and non-proteids. Fatty matters. Non-nitrogenous extractives; pentosanes, cellulose.

Co-efficients of digestibility. Circumstances exercising a notable influence on the digestibility of aliments. Digestibility among ruminants, horses, and among pigs. Digestibility and conception of the nutritive relation.

Classification of aliments. Coarse aliments. Straws, grasses, green fodders. Concentrated aliments. Roots and tubercles. Cereal and leguminous grain. Bran, oil-cake, molasses and other industrial residues. Aliments of animal origin. Place of the pasture herbs.

The poisonous principles in aliments. Means of preventing their dangers.

Specific action of aliments on the working of the digestive canal. Condiments.

Preparation of aliments.—Ultimate advantages and inconveniences of the preparation of aliments. Examination of the modes of preparation. Cleaning. Mechanical division; chopping, grinding, flattening, crushing, grinding. Maceration. Fermentation. Making into head. Maltage. Ensilage.

Substitutes for aliments.—Economic interest of alimentary substitutes. History of the question. Equivalents in grass. Nitrogenous equivalents. Conditions of the substitutions. Equivalent rations. Examination of the most economic aliments. Examples of substitution.

Composition of rations—

Volume of the ration. Content as regards digestible nutritive principles. Nutritive relation. Ration tables; their utilisation in computing rations. Examples. Plans of alimentation, their practical utility. Objections to the use of ration tables. Doctrine of maximum alimentation. Pasture feeding. Methodical control of the nutritive results of feeding. Observations and periodic weighing of animals. Evaluation and measurement of products obtained.

Distribution of aliment, and drinks. Hygienic precautions.

(II) *Variation.*

Influence of exercise and rest on the development of the organs. Phænomena of adaptation. Application to zootechnics.

Methods of functional gymnastics—

Functional gymnastics of the digestive apparatus. Procedure; intensive alimentation. Modifications which the organism undergoes under its influence. Precocity; its anatomic and physiological characteristic. Difficulty of realisation; critical periods of lactation, weaning, and feeding in winter.

Functional gymnastics of the apparatus of lactation. Procedure; milking, and the under-beating of the udder; anatomical and physiological effects.

Functional gymnastics of the locomotive apparatus. Procedure. Functional hypertrophy of the muscles. Nervous excitability: "blood." Resistance to fatigue: "heart." Special effects: adaptation of the muscles to the kind of work required. Evidence from experience and observation.

Functional gymnastics of the mental nervous apparatus. Procedure; grooming and handling; bases of grooming; imitation, association of impressions. Obtaining obedience.

Influence of environment on domestic animals—

Direct and indirect influence of the soil. Of climate. Adaptation to climate. Difficulties of acclimatation; practical consequences.

So-called spontaneous variation—

Amplitude of these variations sometimes considerable; their zootechnical interest.

Variation, and the fundamental conception of individuality.

(III) *Heredity.*

General theories of heredity. Their insufficiency from a zootechnical point of view. Transmissibility of characters. Heredity of acquired characters. Heredity of mutilations, of imperfections, of diseases. Heredity of sex.

Modes of heredity—

Unilateral or preponderating heredity; individual hereditary power: good stocks. Bilateral heredity. Function, sire and dam in the characters of production. Distribution of the characters. Doctrine of pairing.

Atavistic or ancestral heredity. Circumstances favourable to the production of the phænomena of atavism or reversion.

Influence attributed to the imagination of the dam on the characters of the productions. Indirect atavism: doctrine of the infection of the dam.

Institution of genealogical books: Stud-books, herd-books, flock-books.

Processes having for aim the direction of the transmission of characters. Artificial selection: its power. Consanguinity; ultimate danger, renewal of the blood. Combined action of artificial selection and consanguinity: fixation and intensification of special characteristics in descent.

Groups formed by domestic animals—

Physiological and morphological species. Polymorphism of the physiological species including the domestic animals. Ideas of race, of sub-race and variety. Attempts to obtain a precise delimitation of these groups. The problems of formation and expansion of races. Signification and importance of the idea of race in zootechnics.

Methods of reproduction—

Aim and classification of methods. Selection. Crossing; continuous and industrial crossing. Mongrel breeds. Hybridation. Zootechnical operations which allow of the accomplishment of each of these methods; opportunity of their use.

Direct and indirect intervention of the State, and in general of collective bodies, with the aim of directing the reproduction of domestic animals. Advantages and eventual inconveniences of this intervention.

(IV)

(IV) *Diseases.*

Difficulties occasioned by diseases in zootechnical operations. Causes of the diseases. Special importance of the infectious and contagious diseases originating with micro-organisms.

Means of defence against diseases due to micro-organisms—

Hygienic measures. Destruction of pathogenic micro-organisms. Antiseptics and disinfection. Isolation of diseases. Difficulties in diagnosis. Inoculation and its diagnostic functions. Tuberculin and mallein; their application to the struggle against tuberculosis and glanders.

Immunity as disease due to bacteria. Natural immunity.

Conceptions of its mechanism; phagocytosis and antitoxic action. Artificial immunity; vaccination and serotheraphy.

Sanitary police. Declaration; its fundamental importance. Diseases of domestic animals due to bacteria, recognised by the sanitary laws. Bacterial anthrax. Symptomatic anthrax. Infectious pneumoenteritis. Contagious peripneumonia. Tuberculosis. Glanders. Rot. Aphthous fever. Mania. Cattle plague, etc. General ideas concerning these diseases; zootechnical importance; modes of contagion and actual means of defence. Assurance against the mortality of cattle.

Second Part.—Special Zootechnics.

(I) *Special Zootechnics of the Bovidæ.*

Statistics. Products supplied by the bovidæ. Markets and prices. Internal and external market. Influence on the orientation of bovine production.

Classification and description of the bovine populations—

Bovine breeds; distinctive characters, zootechnic aptitudes, geographical distribution, exploitation, history of their improvement and their expansion.

Breeds: Durham, Durham-Manceaux; Dutch; Danish; Flemish; Normandy; Hereford; Jersey; Breton; Kerry; Ayrshire; Devon and Sussex; Parthenais; Aubrac and Angles; Limousin; Garronaise; Lourdes; Salers; Ferrandaise; Bernois and Simmenthal; Fribourgeoise; Montbéliarde; Abondance; Fémeline; Glan; Villars de Lans; Charolaise-Nivernaise; Schwytz; Aargau; Tarentaise; Saint-Girons and Aure; Gascony; Bazadaise; Landaise-Bearnaise; Bovine populations of Tunis and Algeria, Guelma; grey breed of the Steppes; Angus; Galloway; Red-polled; West-Highlands.

Exotic bovidæ. Buffaloes and zebus; their climatic adaptation and their eventual importance for colonial countries.

Breeding of bovidæ—

Favourable conditions for breeding. Choice of breed and of method of reproduction.

Selection of breeders. Examination of characters concerning suitability: (1) Meat production (study of the conformation); (2) milk production (study of the milk and butter producing characters); (3) as workers. Examination of the characteristics common to the breeds, whatever be the aim of the breeding. Selection and estimation of the reproducers. Measurements. Method of points. Societies for breeding. Competition and market-competition.

Age of the sires and dams. Manifestation of heat, etc. Season for covering. Gestation. Duration and signs of gestation. Care of females during gestation. Accidents of gestation: accidental and epizootic abortion. Parturition. Precursory signs. Normal and abnormal parturition. Attention to the mother after calving. Consecutive accidents in parturition; non-deliverance, retroversion of the uterus, fever (*fièvre vitulaire*).

Rearing of bovidæ—

Attention to the young after birth. Diseases of calves: Infectious Omphalitis, arthritis, and diarrhœa of the new-born. Feeding of calves. Natural and artificial lactation. Substitutes for milk. Weaning. Régime after weaning, according to the ulterior intention. Hygiene of young bovidæ. Castration.

Production of work—

Conditions of the employment of bovidæ for the production of motive force. Choice of bovidæ for work. Grooming. Harness. Shoeing. Treatment of the bovidæ used for work.

Production of milk—

Methods of milk production. Choice of milch cows. Circumstances which influence the quantity and the quality of the milk secreted. Direct control of the quantity of milk and of the fatty matter produced. Control societies. Feeding of milch cows. Pasturing and stabling.

Collection of milk. Milking; by hand and by machinery. Measures for cleanliness. Conservation of the milk: refrigeration, pasteurisation, sterilisation. Sale of milk. Sterilising of milch cows. Disease of the udders: mastitis.

Production of fat meat—

Production of beef. Fattening of oxen, cows, and heifers. Conditions favourable for fattening. Estimation of the condition of fat: management.

Choice of bovidæ destined for fattening. Pasture fattening. Herbage. Fattening in the stable. Estimation of the live weight and of the net weight in meat. Sale of bovidæ for slaughter. *Co-operative abattoirs.* Production of veal. Fattening calves. Production of white veals. Valuation of fat calves. Management. Produce. Sale.

(II) *Special Zootechnics.—The Ovidæ.*

Products furnished by the ovidæ (sheep, goats, etc.). Markets and prices. Influence on the orientation of production.

Classification and description of the ovine and caprine population—

Sheep.—Dishley breed; Dishley derivatives: Border-Leicester, Lincoln. New Kent. Cotswold. Southdown; Down derivatives: Shropshire, Hampshire, Oxfordshiredown. Polders. Poitevine. Berrichonne and Solognote. Charmoise. Béarnaise. Causses. Larzac. Merino. Dishley-Merino. The ovine populations of Algeria and Tunis. Barbarine breed. Soudan. Bermagasco. Goats.—European goats. Asiatic goats. African goats.

Breeding

Breeding of young ovidæ—
Selection of breed and of the method of reproduction. Selection of sires and dams. Examination of characteristics according to requirements: (1) in the production of meat (study of the conformation); (2) in the production of wool (study of the wool and the fleece); (3) in the production of milk. Hiring of rams.
Age of sires and dams. Manifestation and appearance of heat, etc. Gestation. Lambing.
Lactation and weaning. Treatment ot the young after weaning. Castration.
Administration of the flock.—Choice of the shepherd. Composition of the flock. Branding. Register of the flock. Lodgment. Fold. Feeding. Sheep-dogs.
Production of wool.—Shearing. Condition of the fleeces. Sale of wools. Wool-markets.
Production of milk.
Production of lamb and mutton.—Lamb. Young mutton. Mutton. Fattening in the sheepfold. Fattening on pastures. Mixed fattening. Estimation of condition. Management. Net yield. Sale.
Diseases of sheep: Ulcerous stomatitis, gangrenous mastitis, and various other diseases.

(III) *Special Zootechnics.—Pigs.*

Products furnished by pigs. Markets and prices; influence on the orientation of porcine production.
Classification and description of the porcine populations—
Breeds: Craonaise, Limousine, Mangalicza, Tamworth. Asiatic pigs. Yorkshire; small and large Yorkshire. Essex breed. Berkshire; Poland-China.
Breeding and fattening.—Selection of breed and method of reproduction. Selection of reproducers. Their age. Pairing. Gestation. Parturition. Treatment. Rearing. Lactation. Weaning. Treatment after weaning. Castration. Fattening. Influence of feeding on the quality of the pork. Estimation of fat pigs; handlings. Sale and transport. Hygiene of pigs.

(IV) *Special Zootechnics.—The Equidæ.*

Methods of utilising the energy supplied by the equidæ (horses, asses, mules, etc.).
Description of horses corresponding to various requirements.—Horses: Saddle, coach, quick-draught, slow-draught. Markets and prices for the various kinds; influence on the orientation of production.
Classification and description of the principal populations of the horse, ass, and mule—
The horse: Oriental horse. Pure-blood Arab. Pure-blood Barbary horse. Pure English race-horse. Horses of half-blood, in England, Germany, Hungary, Russia, the United States, and France. *Demi-sang Tarbais.* Half-blood Anglo-Norman (Anglo-Norman trotters). Half-blood Charentais and Vendéen. Orloff's trotters. American trotters. Western horses. Percheronne. Boulonnaise. Suffolk. Clydesdale. Poitevin breed. Belgian and Ardennaise.
Asses.—African. European. Poitevin breed. Mules and their young. Mules of Poitou.
Horse institutions.—Administration of the studs. National, licensed, and approved stallions. Law concerning the superintendence of stallions. Premiums. Competitions. Races.
Breeding and use of the equidæ in agriculture—
Breeding.—Methods of reproduction applicable to the equidæ. Selection of reproducers. Age. Season for covering. Gestation. Parturition. Treatment.
Breeding.—Lactation. Weaning. Treatment after the weaning. Hygiene of the young equidæ. Preparation for shoeing. Castration.
Production of work.—Grooming. Schools of grooming. Use of horses in agricultural works. Breaking-in horses for sale. Commerce in horses.
Final remarks.—The practice of zootechnics; conditions of success; necessity of apprenticeship.

7. *Practical exercises in Zootechnics.*—The practical exercises in zootechnics consist of a preparatory course during the first year, and of practical work in the course of zootechnics during the second year. Its function is to supplement and confirm the preceding course, and it is of an eminently practical character. The programme is approximately as follows:—

1st year: PRACTICAL EXERCISES IN ZOOTECHNICS.

Preparatory Exercises.

Study of the skeleton—
Bones and their various forms.—Short, long, elongated, flat.
Structure.—Dense, spongy, mechanical resistance.
Articular surfaces.—Distribution of pressure.
Chemical composition.—Consequences from the point of view of feeding. Utilisation of bone after death.
Mode of growth.—Exposition with a view to the explanation of the phænomena of precocity.
Head—
Cranial skeleton.—Bones of the skull: Brachycephalic, dolichocephalic. Osseous branches: Correlation of their direction and of the forms of the frontal. Bones of the face: Profile, facial angle.
Teeth—
Comparative anatomy.—Homodontal, heterodontal animals. Incisives, canines, molars: their adaptation to the kind of life; consequences from the point of view of alimentation. Dental formulæ. Development. Structure. Anomalies.
Age.—Characters furnished by the teeth for the determination of age. Eruption of the teeth. Their level. Wear.
Age of the horse.—Dental formulæ in the young and adult horse. Description of the incisors, canines, and molars. Successive forms of the incisive arch and of its profile. Difference between decayed incisors and replacing teeth. Dates of their eruption and of their stages of growth. Formation and successive forms of their surfaces. Razing. Levelling. Irregularities of wear, etc.; long and short teeth.

Frauds:

Frauds: Ageing, rejuvenating. Precedure in the examination of the incisors of the horse.

Age of the mule, of the young mule, and of the ass.—Analogies and differences with the horse.

Age of the ox.—Dental formulæ in the young and adult. Description of the incisors and the molars. Differences between decayed incisors and the teeth replacing them. Dates of their eruption and of their stages of growth. Formation and successive forms of their surfaces. Levelling. Irregularities of wear. Determination of the age by the frontal horns. Frauds. Precocious animals: Differential characters supplied by imbrication, dates of eruption, and examination of the bands of wear of the incisors. Procedure in examining the incisors.

Age of the sheep.—Dental formulæ of the young and adult. Description of the incisors and molars. Differences between decayed incisors and the teeth replacing them. Dates of their eruption and of their stages of growth. Formation and successive forms of their surfaces. Levelling. Irregularities of wear. Precocious animals: Differential characters supplied by the dates of eruption and by the examination of the wear of the incisors. Procedure in examining the incisors.

Age of the pig.—Dental formulæ of the young and adult. Description of the incisors, canines, and molars. Difference between decayed incisors and canines and substitutes. Dates of their eruption. Dates of the eruption and decay of the irregular teeth. Progressive length and wear of the upper canines with the male. Frauds. Precocious animals: Differential characters furnished by the dates of eruption of the incisors. Procedure in examining the incisors. Resection of the incisors and canines of the young: operative procedure.

Study of the Organs.

Digestive organs—

Organs of prehension and mastication.—Lips, tongue, teeth. Mode of prehension peculiar to each kind of domestic animal: consequences from the point of view of pasture and of the conservation of natural and artificial grasses; ringing of the snout of the pig. Mode of mastication of the various domestic animals. Anomalies, disease and irregularities of the molars; procedure in examination.

Œsophagus.—Obstruction by foreign bodies, diagnosis, treatment.

Stomach.—Physiological conditions of the proper working of this organ; consequences from an alimentary standpoint. Stomach of the horse: anatomical description, arrangement of the cardia; vomiting, colic, diagnosis, treatment. Stomach of ruminants. paunch, rumination; meteorism, diagnosis, treatment; puncture of the rumen (paunch), operative procedure.

Intestines.—Colic and intestinal congestions, intestinal worms, constipation, diarrhœa: diagnosis, treatment. Puncture of the cœcum in the horse.

Respiratory organs—

Thorax.—Amplitude, and normal movement in respiration: examination of the flank.

Nasal cavities.—Running, coryza, glanders, diagnosis, treatment.

Larynx.—Paralysis: roaring (*cornage*).

Trachea.—Traumatismus; deformation of the cartilaginous rings. Parasites; precautions.

Lungs.—Pulmonary emphysema: dyspnœa; diagnosis, treatment.

Circulatory organs—

Vascular apparatus—Pulse: exploration in various animals. Hæmorrhage: treatment, dressing. Congestions, insolations: diagnosis, treatments. Bleeding: the jugular, mammary, and saphena veins; use of fleams and trocars; amputation of the tail, operative method.

Genito-urinary organs—

Male apparatus.—Comparative anatomy: consequences from the standpoint of the duration of the coitus in the various species. Diseases: balanitis in the bull, diagnosis, treatment. Castration: ablation of the testicles, use of bistoury, ligaturing. Obstruction of the urinary tracts: colic, diagnosis; examination of the *fossette du gland* in the horse; calculus, rectal palpation of the bladder in the horse and ox, puncture of the ureter.

Female apparatus.—Comparative anatomy. Disease. Heat in the cow, diagnosis, treatment. Physiological conditions of fecundation. Acid secretions of the vaginal mucous, spasm and obstruction of the neck of the uterus, diagnosis, treatment, operative procedure.

Organs of locomotion—

Encolure (neck and shoulders).—Its rôle in locomotion.

Members.—Comparative anatomy and synonymy of the parts. Straightness. Forefeet. Gait. Blemishes of the skin, of the subcutaneous conjunctive tissue (hygromas), of the tendons, of the synovial regions, of the osseous tissue (fractures, spavins, splints, etc.). Comparative anatomy of the hoof, formation, defects, blemishes, etc. Utilisation after death.

Muscles.—Extensors, flexors, elevators, depressors. Chemical composition. Growth in the young: consequences from the point of view of feeding. Flesh. Synonymy of the parts from the point of view of sale as meat.

Second Year: Practical Application of the Course in Zootechnics.

General Examination of an Ox.

Means of handling it without danger.

Visual examination, manual examination.—Conditions of a good examination.

General signs of health and sickness.—Procedure for the examination of the attitude, the hair, the skin, the mucous secretions, the rectal temperature; use of thermometer.

Age.—Manœuvres to open the mouth in order to examine the incisors.

Race.—Examination of the indications furnished by the horns, the bones of the head, the colouration of the mucus, the coat, the body.

Conformation.—Procedure in exact estimate of it. Use of the toise.

Examination

Examination of the Cow as regards its Value for Milk and Butter.

Breasts.—Visual examination of the udder: Form, extent. Position, number and size of the teats. Handling of the udder: Palpation of the skin, of the glandular tissue. Milking. Exploration of the sub-cutaneous abdominal veins, of the inferior mammary glands, of the so-called perineal veins, etc. The hide. Examination of the sebaceous deposits.

Estimation of the State of Fattening.

Ox.—Estimation of carcase weight. Estimation of the live weight: Use of the zoometric tape.
Calf.—Estimation of the quality, carcase weight, and live weight. Determination of age.

General Examination of Sheep.

Examination of the health.—Exploration of the eye.
Of the age.—Exploration of the incisors.
Of the conformation.
Of the wool.
Of the fattening.—Estimation of the live weight.
Of the breasts.
General examination of the pig.—Examination of the health: Of the tongue, age, conformation. Estimation of the live weight, etc.

8. "*Conferences*" *in aviculture.*—There is an equally sufficient course in aviculture, which is dealt with under the following heads, viz.:—

(1) Definition of general aviculture;
(2) Avicultural zootechnics;
(3) General conditions for production;
(4) Classification of the birds of the poultry-yard;
(5) The Gallinæ;
(6) The Palmipedes;
(7) Raising;
(8) Rearing;
(9) Egg-production;
(10) Raising for table;
(11) Production for feathers;
(12) Yarding;
(13) Diseases;
(14) Parasites.

Under each heading the subject is treated with adequate fulness, which it is perhaps unnecessary to reproduce.

9. *Agricultural machinery and rural construction.*—This important section is treated thoroughly, 40 lectures being given. The programme is as follows:—

AGRICULTURAL MACHINES AND RURAL CONSTRUCTION—PROGRAMME.

(40 Lectures.)

Introduction.—Aperçu of the history of instruction in rural engineering (Roville, Grignon, Grand-Jouan, La Saulsaie, Institut National Agronomique de Versailles, Conservatoire Nationale des Arts et Métiers, Montpellier, Institut National Agronomique).
General programme of the course, and exposition of its method.

AGRICULTURAL MACHINES.

(I) *General Introduction and Preliminary Ideas.*

Importance to agriculture of machinery.
General considerations respecting the invention, development, construction, sale, and use of agricultural machines; increase of the number of the types of machines necessitated by modifications in cultivation.
Tests of machines; practical work effected, cost of working; special co-operation; mode of test; judging agricultural machinery.
Choice of the purchase of machines; maintenance and repairs, etc.
Accidents occasioned by agricultural machines; preventive means; apparatus of protection of workmen.
General classification of agricultural machines according to agricultural operations; preparation of the soil; sowing and subsequent attention; crops; transporting; preparations of crops in view of selling and consumption.

(II) *Work of preparing the soil.*

Study of soils and cultural dressings from the point of view of rural engineering.
Hand-labour: Spade, hoe, pick, mattock, and shovel.
Work with aids: Ploughs. Historic aperçu; general description of the plough.
Study of the functions of the different parts of the plough, of various kinds of plough, and ploughs for different purposes.
Brabant double-ploughs; balance ploughs. Multiple ploughs or with several furrows.
For special work: fallow and deep ploughing; sub-soil ploughs. Vine-dressing, rising ground, trench ploughs; various other types. Dynamics of the plough.
Scarifiers.—*Extirpators.*—*Cultivators.*—Form and dimensions of the working parts according to the character of the work to be done. Machines with rigid teeth and with flexible teeth.
Harrows.—Principle of the mode of action of the teeth of the harrow. Trailing harrows with teeth; rotatory, rolling, and various other kinds of harrows.
Pulverizers.—*Rollers.*—Clod-breaking and various other kinds of rollers.

Work

Work of teams.—Available energy; influence of the harness and of the number of animals in the teams. Arrangement of ploughs for deep ploughing, etc., and management of teams.
Mechanical cultivation of the soil.—General principles relative to the use of mechanical systems of the cultivation of the soil.
Steam cultivation.—Various locomotive and direct traction; automobiles with fixed wheels and axles, various systems:—*The use of electricity.*

(III) *Sowing and subsequent work.*

Distributers of Manures.—Spreading out manure.—Distributers of liquid manures.—Distributers of pulverulent manures.—Testing, regulating, and work of drills.
Transplanters.
Work during growth of crop.—Hoes, for a single row, for angular or parallel expansion; multiple hoes; explanation of various systems of hoeing.
Various machines.—General aperçu concerning the other tools used during growth of crops; treatment in respect of insects, noxious plants, cryptograms, etc.

(IV) *Harvesting.*

Hand-cropping.—Fodder and cereals. Sickle, scythe, pitchforks, rakes, etc, etc., etc.
Machine Harvesting.—(Fodders, cereals, roots, and tubercles)
Reapers.—Cutting instruments, mechanisms of transmission; one-horse reapers, two-horse, two-oxen.
Haymaking machines.—Machines with continuous and alternate movements.
Horse rakes.—Various kinds.
Mechanical loading of Hay: Machines for directly loading the hay in the vehicles.
Mechanisms for loading hay in rural buildings.
Reaping machines, various forms.
Independent binders.
Reapers and binders.—Reaping machines for maize and rice. Binding thread.
Automobile machines.—Reapers and binders, etc., etc.
Study of the economics of harvesting with reference to the processes and the machines employed.
Harvesting.—Tubercles, and roots. Hand and plough work. *Collectors for tubercles and for roots.*
Various other crops:—Hemp, etc., etc.

(V) *Carriage.*

Fundamental data of agricultural transport.
Sledges—Wheelbarrows.
Vehicles: Carts, tumbrels, drays. Lorries: waggons. Small agricultural railways. Road locomotives and automobiles.

(VI) *Treatment of crops in respect of sale or consumption.*

Threshing Flail.—Dépiquage (threshing by trampling down, by horses or mules), wheat, barley, etc.
Sledges.—Rollers.—Threshing machines.—Various forms of hand and other threshing and cleaning machines.
Threshing machines for medium and large operations, for various kinds of grains.
Attachments for the prevention of accidents.
Handling of the grain.—Apparatus for cleaning, sorting, preparing for consumption, crushers (cylinders and plates), small flour-mills, etc.
Fodder.—Compressors; presses, hand and machine presses.
Roots, tubercles, oil-cake, etc.—Apparatus for cleansing, washing, cutting, pulping, rasping, etc., roots and tubercles.
Apparatus for preparation of foods for cattle.
Factories for the mechanical preparation of food for cattle.
Arrangement according to the magnitude of the undertaking.

The development in such case is about as follows:—

(a) Rapid historical aperçu.
(b) Study and description of the different working parts of the machinery.
(c) Dynamics of the mechanisms. Results of experiments.
(d) Information as to use and quantity of work effected.

A large number of mounted drawings are at the disposal of the pupils, and tables of the principal results of experiments.

The instruction in the lecture-room is supplemented by—

(i) Visits to collections of models at Noisy-le-Roi and Paris.
(ii) Practical exercises at the station for machine testing, and in the field.
(iii) Visits to exhibitions, shows, etc.
(iv) Excursions to workshops for the manufacture of agricultural and industrial machinery, and factories using or developing agricultural productions.

10. *Rural construction.*—In Europe the climate involves far greater attention to the matter of rural construction than is generally necessary in this State, besides which the local traditions involve a treatment of animals with greater care than is characteristic with us. The course having reference to this matter is developed about as follows:—

General introduction and preliminary ideas.

General aperçu. Importance of buildings having regard to the extent of the property and the nature of the agriculture. Distinction between urban, industrial, and rural construction. Plans, sketches, and designs.
1st *Part.—General principles of construction.*
Staking out, and profiles of surface.
Terracing.
Masonry.—Stones, merlons, walls, retaining walls, etc. *Carpentry.*

Carpentry.—Wood, strength. Scarfing, etc. Various structures of importance.
Roofing.—Vegetable, mineral, tiles, iron, etc.
Joinery.—Parquetry, staircases, windows, doors, etc.
Locksmithing.—For large and small buildings, gates, etc.
Glazing and painting.
Various other kinds of work.—Paving, bitumen, asphalt, etc., etc.
Conservation and repair of old buildings.—Masonry, carpentry, painting, paving, etc.
Estimate of buildings.—Insurance against fire, etc.

2nd *Part.—Buildings for agricultural exploitation—*
General rules as to different buildings required. Classification.
(a) *Habitations.*—Aperçu of the history of dwelling-houses, and of rural buildings. General conditions for building houses for human residents.
Heating and ventilation.—Sewer arrangements.
Dwelling for farm hands, for the factor, small, medium, and great culture.
(b) *Stabling for animals.*—General considerations, ground, flow of urine, ventilation, lighting, arrangements for feeding, placing of the animals, mode of fastening, disinfection of animals' stables, etc., annexes.
Housing of horses, oxen, sheep, pigs, poultry, dogs, etc.—The general arrangements are examined for each case, and types are fully illustrated.
(c) *Annexes.*—Preparation of food. Collection of manure: latrines.
(d) *Housing of crops.*—Most healthy arrangement, temperature, openings, floors, elevators, storing, and despatch of produce. Modes of keeping cereals, maize, tobacco, forage, roots, tubercles, silos, etc.
(e) *Storage.*—Of fertilisers, etc., houses for vehicles, etc., wooden structures, workshop for repairs.
(f) *General arrangement of farm.*—Disposition of buildings. Hygiene. Economic conditions. Relative importance of the different buildings. The whole considered in reference to small, medium, and large farms, and extensive domains.
(g) *Special structures.*—Bakeries, dairies, cheese factories, caves, cellars, factory for feculas, distillery, sugar factory, silk-worm houses, roads and paths, aqueducts, etc., reservoirs, distribution of water, closures.

To give practicality to the theoretical work, various practical exercises regarding materials of construction and their arrangements and use, are undertaken. Plans and drafts of schemes are examined, and suitable visits are made to examine rural constructions.

11. *Practical exercises.*—The pupils are taken in small groups, and examine the various models; their use is explained, they handle the instruments themselves, and learn thoroughly their use. At the end of each class, each pupil may obtain such supplementary information as he desires.

12. *Agricultural Technology.*—This important course occupies 37 lectures. It covers a very wide range, indeed, viz., the manufacture of beet and cane sugar, of feculas and starch, wines, cider, beers; distillery; milling and baking; manufacture of oils, perfumes, turpentine, charcoal, fertilisers, preparations of vegetable fibres, conservation of fruits, etc, manufacture of butter, cheese, etc. The programme is as follows:—

Manufacture of Beet Sugar.

Origin of production of beet sugar.—Rôle of the government of Napoleon I. Comparative production of different European states.
Glance at the legislation relating to sugar, referring to manufactures, exportation, internal consumption.
Characteristics of sugar-beets.—Form, skin, root, leaves, chemical composition and anatomical constitution.
Handling of beets from the ground to factory. Hydraulic transporters.
Washing, etc.
Extraction by diffusion.—Root-cutters. Theory of diffusion. Endosmosis and exosmosis. Osmotic pressure. Velocity of osmosis across tissues. Crystalloids and colloids. Diffusion battery, heaters, handling of the valves, utilisation of residuary liquids, Klusemann and Bergreen's presses, alimentary value of the residue, its dessication.
Chemical purification.—Action of lime. Theory of double carbonating. Limekiln. Washing with CO_2. Gas-pump. Preparation of milk of lime. Double carbonating. Continuous and other carbonaters. Triple carbonating. Filter-presses. Electro-dialysis of syrup. Mangano-electric process.
Clarification of juice.—Mechanical filters.
Evaporation.—Theory of evaporation *in vacuo*, and of heating by multiple effects. Apparatus for evaporating by triple, quadruple, and quintuple effect. Multiple heater. Steam circulators. Surface and barometric condensers.
Clarification of syrups.—By mechanical filters; use of Kieselguhr.
Sulphiting the syrup.—Production and purification of sulphurous acid. Discontinuous and continuous sulphiters. Filteration. Hydrosulphitation.
Boiling the syrup.—Furnaces, vertical and horizontal, etc.
Preparation of the boiled mass, turbinage.—Clearing of syrup and steam, rich and poor runnings, their separation. Work of second and third gets. Return of runnings to boiler. Crystallisation in motion. Recasting of the second and third gets, and return in work of sugar recast.
Extraction of sugar from molasses; control of operations.—Purchase of beets by density, coefficient or quotient of purity, and saline coefficient or quotient. Use of the saccharometer. Normal weight.
Processes of refining.—Refining in manufacture. Moulding of the sugar.

Manufacture of Cane Sugar.

Statistics of production of cane sugar.
Description of Sugar Cane.—Histological and chemical constitution. Expressing the juice. Application of diffusion to juice extraction. Use of lime, evaporation, boiling. Old and modern processes.

Manufacture

Manufacture of Feculas and Starch.

Comparative position of both industries. Statistics.
Farina from potatoes, starches.
Manufacture of feculas.—Washing, etc., rasping, extraction of the fecula; second, rasping and extraction, collection of the rough fecula, cleaning, turbinage and drying.
Manufacture of starch.—Wheat starch, by various processes. Martin's process. Maize starch by soda; by sulphurous acid. Rice starch.
Manufacture of dextrine and glucose.

ŒNOLOGY.

Production of the vine, and history of the same.
Chemical Composition.—Different parts of the grape taken from different vineyards. Studies of chemical and biological phænomena during the course of vinification. Transformation of the products of the grape; composition of wine.
Manufacture of Wine.—Collection, pressing, fermentation, supplementary fermentation, etc., of red and white wines, and the utensils, etc., required.
Prophylaxis in respect of diseases of wine.—Preservation, plastering, treating, etc., etc.
Preparation of sparkling and ordinary wines, of vins-de-marcs, des piquettes, etc.

Cider-making.

Production of cider; position of industry.
Composition of cider apples.—Chemical and biological phænomena of fermentation, and the changes that they bring about in the composition of apple-juice.
Manufacture of cider.—Pressing, etc., employ of diffusion, fermentation, utilising of the marc; manufacture of sparkling ciders.

Brewery.

Production of beers: general position of industry.
Composition of barley and of malt; of hops.
Theory of diastase saccharification.—Amylase and dextrinase. Arrest of saccharification. Immobilsation of the diastase by boiling.
Beer fermentation from the theoretical point of view. Yeasts. Use of pure yeasts.
Malting of barley.—Moistening, germination, malt-kilns, pneumatic and mechanical malting.
Brewing by decoction.—"Dickmaische" and "Lautermaische." Treatment of hops.
Brewing by infusion.
Cooling.—Introduction of yeast; fermentation; high or low fermentation, cooling.
Pasteurisation of the beer.
Use of malt, etc.

Distillery.

Statistics of production and consumption of alcohol. Uses of brandy and alcohols in industry, etc. Lighting, heating, motive power.
Principles of distillation.
Manufacture of wine-brandies in "les Charentes," in "Armagnac," in "le Midi." Manufacture from the "marc," from fruit, from cider.
Distillation from beet-root. The Champonnois process. The diffusion process, fermentation, distillation, use of pulp.
Distillation of Jerusalem artichoke (*topinambours*).
Distillation of cane-sugar molasses: rum and "*tafia.*" Of beet-sugar molasses. Utilisation of residues.
Distillation from saccharified grain: (1) by acid; (2) by malt. Action of yeast, of the amylomyces. Collection of yeast. Value of malt.
Distillation from potatoes. Rectification of the raw product: manufacture of artificial brandies. Denaturing the alcohol.

Flour-mill.—Bakery.

Histology of a grain of wheat. Chemical composition and food value of its different parts; necessity of removal of the envelope and the germ.
Apparatus for cleaning grain. *Grinding by means of cylinders:* history. Preparation of the millstones: milling. (This is dealt with fully.)
Other milling machines.
Composition of flours, its different grades, of other products in milling; examination of flours, qualities necessary for bread; the constituent elements of gluten.
Bread-making on the farm. Theory of making, hand and mechanical kneading, fermentation, baking.

Oil manufacture.

Statistics; position of olive-oil manufacture and of the seed-oils.
Manufacture of olive and nut oil; of colza, nut-oil, sesame, linseed, cotton-seed, coco-nut, etc..

Manufacture of Perfumes.

Composition of "*essences*," their properties, and use. Use of synthetic products.
Distillation of Rose-attar in Turkey and in Southern France; of neroli, peppermint, geranium, rosemary, thyme, lavender, etc.
Enfleurage.—Of jasmine, tuberoses, violets, etc. Solution of perfumes in carbon-disulphide, petroleum, ether.
Extraction by rasping, pressure, etc., of oils of orange, lemon, citron, etc., etc.

Manufacture of Essential Oil of Turpentine.

Position of the industry.
Composition of the resin, of the essential oil, of colophony.
Uses of the essential oil and colophony.
Obtaining resin from the maritime pine of the Landes. Yield of pines in resin. Distillation of resin. Yellow resin. Yield.

Manufacture

Manufacture of Charcoal.

Comparison of the composition of wood and of charcoal.
Theory of carbonisation. Modes of carbonisation. Distillation of wood; collection and utilisation of by-products.

Manufacture of Manures.

Transformation of waste-products of the residues of factories; conversion of animal matters into manures. Blood, skins or hides, leather, horn.
Bone, green, degelatinised, precipitated phosphate of lime.
Origin of sodium nitrate. Refining.
Manufacture of ammonium sulphate, of gas; distillation of bones.
Extraction and refining of potassium salts at Stassfurt.
Origin of dephosphorised wastes.
Extraction, enrichment, and drying of French, Algerian, and Tusinian phosphates of lime. Manufacture of superphosphates.

Retting of textile plants.

Layering of flax (linum usitatissimum) and hemp; theory of retting.
Retting of flax in running and still water and on meadows. Of hemp in rivers and on meadows. Retting of jute, ramie-fibre, etc.

Conserves.

Principles of preservation of foods. Conservation by drying. Fruits, peas, beans, etc.
By antiseptics. Salt, sugar, acetic acid.
By heating. Legumes, fruits.

Milk industry.

Constitution and chemical composition of milk; variations in its composition; statistics.
Control of its purity. Rapid determination of cream and butter. Content.
Organisation of a dairy.
Collection of milk, cooling, despatch. Pasteurisation, condensing, sterilisation.
Spontaneous separation of cream. Mechanical separation. Creameries.
Preparations by polarisation.
Manufacture of butter.—Theory of churning. Acidification of the cream. Churns and churning. Washing and malaxage. Utilisation of skimmed milk.

Manufacture of Margarine.

Cheese manufacture.

Theory of curdling, and of maturing cheese. Pure ferments. Camembert, Brie, Dutch, Roquefort, Gruyère cheeses. Composition and alimentary value of cheeses.

The above gives in mere outline the subjects covered by the course in Agricultural Technology. It is obviously extensive, and fairly thorough.

13. *The Economics of Forestry.*—The importance of this subject generally, and to our State in particular, might seem too obvious to need mention, were it not for the fact that the exploitation of our forests is often spoliation, and there is, from the continental point of view, no adequate regard for our future.

The course is treated as follows:—

The Economics of Forestry.

Introduction.—Definitions. Elements of the economics of forestry. Preliminary ideas. Importance of sylviculture to France.

I. *Relations of the Forests to the Soil, to the Climate, to the needs of Man or Society.*

(A) *Relations of the Forests to the Soil.*

Generalities: Vegetable earth and its geological basis; formation of vegetable earth; its various origins.
(1) *Influence of the soil on forest-lands*—
Properties which the soils of forests ought to present. Preponderant rôle of water. Study of the various components of the soil and various earths from the standpoint of their affinity for water.
Nature of the geological foundation; its inclination.
(2) *Reciprocal influence of the forest-lands on the soil*—
Mechanical, physical, and chemical actions.
Formation of humus. Its various rôles. Conclusions. Comparison between the agricultural and forest cultivation, especially from the point of view of the soil.
Permanence of species.
Particular exigencies of species from the standpoint of the mineralogical composition of the soil. Calcareous and non-calcareous soils. Indifferent, selected, and characteristic species. Species that select and that avoid lime.
Relation between the mineralogical composition of the soil and the forest distribution.
Forest distribution from a geological standpoint.

(B) *Relation of Forests to Climate.*

Generalities: General climate; heat at the surface of the earth; chief circumstances which influence the distribution of this heat; modifications occasioned by the principal meteorological factors.
(1) *Influence of the general climate and of meteorological factors on forest-lands*—
Temperature. Humidity. Light. Electricity. Winds. Mists. Fogs. Rain. Snow. Hail. Dew. White frost. Hoar-frost. Glazed frost.
Climate from a more limited standpoint; local climate; climates of plain, of mountain, of slope, or of hill.
Influence of the local climate on forest vegetation.
Relation between the relief of the ground and forest distribution.

(2) *Reciprocal influence of forests on the climates and on meteorological factors—*
Temperature. Degree of humidity (absolute and relative). Rains (formation and distribution). Winds. Hail. Dew.
General distribution of the waters.
Springs and water-courses (three components: evaporation, percolation, flow).
(a) Study of evaporation. Influence of forests thereon.
(b) Study of infiltration and percolation. Influence of the forests thereon.
(c) Study of streams. Influence of forests on streams. Résumé and conclusions.
Accidental circumstances. Floods. Principal causes. Influence of forests on floods.
Torrents in general. Their effects and causes.
Alpine torrents. Origin of ancient torrents; of recent torrents. Influence of forests thereupon.

(C) *Relations between Forests and human needs.*

Influence of man on forests.—Exploitations for the satisfaction of his need. *Influence of forests on man.*—The products they supply to him.

(1) Material products of forests—
Classification according to human needs. Firewood, timber for general use, industry, etc.
Classification of woods according to their density. Elementary chemical composition of woods. Immediate composition.
Structure of woods. Elementary tissues or anatomical elements of the annual layer. Relation for the same species between the thickness of the annual yield and the density of the wood, or qualities determined by density.
Form of the annual growth. Medullary canal. Pith. Medullary spots.
Sap-wood and heart. Transformation of the sap-wood.
Defects, vices, and diseases of woods.
Aspects of trees at different stages of growth. Annual consumption of wood in France.
(2) Immaterial products of forests.
Action of forests as it relates to the existence and the health of man, and as to his security.

Study of species from the standpoint of the three relations previously referred to.

(1) Leafy species.

The oak genus; characters common to the eight or indigenous species.
(1) Oaks with caducous leaves. Distinctive characters.
(2) Oaks with persistent leaves. Distinctive characters.
Supplementary study of the oak from the point of view of the production of tan-bark and cork.
Beech. Yoke-elm. Chestnut-tree. Birch-tree. Alder-tree. Maple-trees. Elms. Ash-trees.
Linden or Lime-tree, Poplar (Aspen, white, gray, black, Canadian, etc.):
Willow (marked and white willows):
Osier willows (white willows, viminal, almond, purple, fragile, etc.). Production and maintenance of plantations of willows or osier-beds.
Wild cherry-tree, beam-trees, mountain-ash, hazel-tree.
Robinia pseudo-Acacia (the Locust-tree of the United States).

(2) Resinous species.

(A) Fir-trees: Fir-tree properly so called, epicea, larch.
(B) Pine-trees.
(i) Two-leaved pines, sylvestris, maritime, Aleppo, laricio, black or Austrian, mountainous.
(ii) Five-leaved pines. Cembro. Weymouth.

Differences between pine and fir-trees from the point of view of forest culture.
Differences between the resin and the leaves from the point of view of forestry.
Fructification of the various kinds.
Geographical distribution of the most important species.
Conclusions.
General law relative to the position of species, and to the higher limit of vegetation.

II. *Means of utilising or ameliorating the relations of the forests to the soil, climate, the requirements of man.*

Methods of Treatment.

Forests of tall trees.
(A) Forests in the state of nature;
(B) Tall trees before 1669: method of gardening;
(C) Treatment of tall-forests prescribed by the ordinance of 1669; method of taking and planting.
(D) Treatment actually in force; mode of clearing.
Regeneration and improvement (theory and practice).
Mode of forced culture in three special circumstances. Application of the mode of thinning. Application of the mode of culture.
Felling, dressing, and removal of the products in tall forests.

Copse.
Two modes of treating: simple copse and undergrowth in tall forest.
(A) Simple copse. Special features. Matters relating to simple copses, and to copse-undergrowth (felling, dressing, and clearing of the products in the copse).
Simple copse of oak (evergreen oak, kermes and tauzin; English and pedunculate oak.
Copse Sarté (1) variety of simple copse: Sartage. Advantages and inconveniences.
Simple beech copse, and other kinds.
Simple copse of the chestnut-tree, of the alder-tree, of the robinia, of mixed species.

(B) Copse under forests of tall trees. Generalities.
Staddling.
Number of the reserves.
Laws relative to the intensity of the thicket: consequences.
Works of maintenance of the copse in tall forests.
(a) Copse: artificial re-stocking, clearing, etc.
(b) Reserve: pruning, lopping.

Artificial reafforestation.

(A) Seed-plots.
Collection and conservation of seed. Qualities. Preparation of the ground (weeding and burning, rendering wholesome).
Season to adopt. Quantity of seed. Seed-plots properly so-called; transplantation.
Special matters:—Seeds of oak, beech, fir, epicea, pinus, sylvestris, maritime pine.
(B) Plantations. Generalities. Plants taken from the forest. Nurseries. Site.
(a) Cultivation of plants in a nursery.
(b) Maintenance of the nursery and of plants.
(c) Improvement of plants.
(d) Removal of plants.
Plantation properly so-called, season to adopt, making the holes, spacing the plants, setting.
Maintenance of seed-plots and plantations.
Selections for re-stocking (species and mode).
(C) Cuttings.
(D) Layers.
Influence of the humidity on the success of the artificial reafforestation, and in general on the existence of forests.

Estimate of wood.

(1) Single trees of large dimensions. Contents of the trunk, and of the upper part (great branches and twigs).
(2) Trees of large dimensions (3 cases).
(3) Young wood (2 cases).
(4) Mixture of young and of old wood.

Sale of wood.

(1) Wood for general purposes.
Timber-works. Railway-sleepers. Telegraphic posts. Mine props, etc. Measuring, cubature, and sale of round and square timber.
Ship timber.
(2) Timber for industry, manufacture, etc.
Sawn oak, beech, fir, epicea and wild pine.
Split timber. Oak Split beech shaping and manufacture of sabots: split fir and epicea.
(3) Firewood.
Block. Round log. Small timber. Fagots. Brushwood. Factors of transformation applicable to firewood.
Yields in wood-work and in firewood of trees that may be cultivated in the copse and in the tall forests (results of experiments).

Carriage of Timber.

Transport properly so-called: (3 cases to be discussed in carriage of timber). The cases discussed are carriage, viz., direct labour, by beasts of burden, by streams, rafts, etc., over various classes of roads, in railways, and canals.
Cost per kilometre.
Cost of maintenance of roads per kilometre; of carriage per ton, per kilometre.
In practice: initial carriage, unloading, *i.e.*, secondary carriage, concentration of products, carriage to market.

Money value of fallen timber.

Determination of the net value.
Wood for industries. Firewood.

Conservation of Timber.

(1) Fallen timber.
(a) Firewood.
(b) Lumber. Natural processes: aeration, immersion. Artificial processes: coating, injection.
(2) Fallen timber. Insects. Cryptogamic invasions. Mammifera (game). Fire. Removal of dead leaves.

III. *Choice and Application of Method of Treatment in the highest interests of the proprietors.*

Management of Forests.

Object to be attained. Problem to be solved. Successive operations; abridged theory of management; practice.
Statistics. Possibility of exploitation.
(A) Exploitability with reference to products.
(B) To the régime and the mode of treatment.
(C) To the position of the proprietor.
State. Individual. Commune.
Plan of exploitation of the copse. Plan of staddling. Of regular tall forests. Feasibility.
Course to be followed in artificial forests of tall trees.

Estimation

Estimation of value and quantity of timber in forests.

Commercial value of the capital.

Nature of the value of forest property. Its possible transformation. Value estimated on the basis of its stock of timber and its area.

Principles on which the rational estimation of a forest rests.

Preservation of timber in its actual condition.

Transformations or modifications of a forest for which three hypotheses concerning the copse may be considered.

(1) Grubbing up.
(2) Modification of the scheme of management.
(3) Change in the exploitation period and scheme of treatment.

Method to follow in the case of forests of high trees.

Formulæ applicable to the calculations and estimation of the wood.

IV. *Political Economy applied to forestry questions.*

Obstacles encountered in the science of forestry; dangers which menace, or which have menaced, forests; causes which oppose the development of forestry, and which modify it.

(1) General causes determined by the relations of the forests of all kinds to the requirements of the agricultural and pastoral industries; by competition with coal, iron, foreign woods; and finally by the insufficiency or imperfection of the means of transport, from the point of view of forestry itself.

(2) Special causes, inherent in forests of each kind, variable according to the position of the proprietor.

(i) Forest belonging to individuals.
(ii) To communes and public bodies.
(iii) To the State.

It may be mentioned that the special course in Forestry in all European countries is very thorough.

14. *Course in Viticulture.*—The course in viticulture is not identical year after year. It consists of 25 lectures. These, of course, cannot possibly traverse the subject with ideal thoroughness; but the generalities are always included, and each year a particular feature is thoroughly discussed. This has the advantage that the general outline is kept before the mind of the student, and at the same time typical thoroughness of treatment is exemplified, and remains as a model for further study of the subject should the student specialise therein.

The programme of the course is as follows:—

Viticulture.

Climatology, Geography, History.

(1) *Importance of Viticulture in France and in foreign countries.*—Comparison of the culture of the vine with the other cultures in France. Value of the soil and of the products, cost of culture. Constitution of viticultural property. Economic crises in viticulture and their reaction on public wealth and population. Gross and net products, yields. Statistics of the cultivation, production, and consumption of wine.

Wine and hygiene; wine and taxes; wine and international relations; wine in relation to the agricultural wealth of France.

(2) *Influence of Climate on the cultivation of the Vine.*—The cultural limit of the vine throughout the world. Influence of latitude. Temperature, rain, light. Local influences: altitude, aspect, situation.

Phases of vegetation. Period of vintage, the temperature, influence of species, and of the vines, precocity.

Viticulture in the French colonies, in sub-tropical and tropical climates.

Influence of climatic conditions on the quality of the wines produced; characteristics of the great French wine regions, and comparison with the foreign wine-producing countries.

(3) *Geographical distribution of the Vine.*—Comparison between wild and cultivated vines; cultural and botanical limit. Extreme climates and special processes of culture.

Influence of the economical conditions of production on the cultural limit. Retrogression of the culture of the vine to its cultural limit, in France and in foreign lands, under the influence of economic conditions.

(4) *Former distribution of the vine.*—Fossil vines. Origin of the culture, general history.

(5) *History of French Viticulture in various parts of France.*—Actual condition; general statistics of viticulture and of production in the various *Départements*.

(6) *Geographical, topographical, and cultural study* of the French wine-growing; general character of the culture and of the wines produced.

(A) South-West. (B) Charente. (C) Wine-growing of the Loire. (D) Champagne. (E) The Northern region. (F) Wine-growing in the East. (G) Burgundy. (H) Beaujolais and Mâconnais. (I) Banks of the Rhone. (J) Provence, Languedoc, and Roussillon. (K) Algeria and Tunis.

(7) *Wine-growing in foreign lands.*—Importance, wines produced, general characters of the culture, exportations.

(A) Italy. (B) Spain. (C) Portugal. (D) Greece. (E) Switzerland. (F) Germany and Austria-Hungary. (G) Principalities of the Balkans and Russia, Turkey in Europe, and Turkey in Asia. (H) America: Chili, Argentine Republic, Peru, Brazil, Bolivia, and Uruguay, Mexico, California, and United States.

Ampelography.

Ampelography.

(1) *Family of Ampelideæ.* Various kinds and their cultural value.
(2) *Genus Vitis, and species.* Cultivated vines. Morphology, anatomy, and physiology. Branches and tendrils. Débourrement, pleura, *aoûtement* (ripening in the heat of August), Roots. Leaves and functions. Flowers and efflorescence. Fruits and maturation. Seed: specific characters.
(3) *Vitis Vinifera*, characters of the species, varieties and variation, the *cépage*, History of Ampelography. Ampelographic systems.
(4) *Importance of the vine and of its cultural value*; "*encépagement.*" Ampelographical descriptions.
(5) *Monographical study of vines and their cultural value.*—(A) Vines of the Gironde and of the South-West, types of *encépagements* in the Medoc, the Graves, the country of the Sauternes, Palus, Saint-Emilion, the Côtes, the Dordogne, Gers, the Landes, the viticulture of the Garonne. (B) Vines of the Charentes, Deux-Sèvres and Vendée. (C) Vines of the Loire, of Anjou, and of Saumurois. (D) Vines of the North and Central France, early vines. (E) Table grapes and preserved grapes. (F) Vines of Burgundy, of Champagne, of Yonne, of Beaujolais, and of Mâconnais. (G) Vines of the East, of Alsace, and of the borders of the Rhine. (I) Vines of the South: Languedoc, Provence, Roussillon, Algeria, and Tunis. Formulæ of *encépagement.* (J) Principal Spanish, Portuguese, Italian, Swiss, Algerian, Asiatic, and American vines. ......

(I) *Culture.*

Pruning.

(1) *Pruning the vine.*—Principles and generalities. Formative and grape-bearing branches, their selection. Pruning the wood of the year and old wood, etc. Instruments. Periods of pruning.
(2) *Systems of pruning*: Their comparative value in the various regions, their influence on the quality and productivity.
(3) *Principal systems of pruning of the various viticultural regions of France.*—Formation, management, and maintenance of the vine, espaliers, etc., etc. The South, Beaujolais, and Charentes. Medoc, Graves, Sauternais, Saint-Emilionais, Palus, Côtes. Isère, Alsace, Yonne. Burgundy, Champagne, Ermitage, Côtie-Rôtie. Guyot, Dubreuil, Cazenave, Marcon, Thomery, Royat, Sylvoz, Mesrouze, Walfard, Chaintres, Quarante, double Guyot systems, etc.
(4) Support of vines, props, training on iron wire.—Various net costs.
(5) *Green prunings.*—"*Epamprage*" (lopping off the leafy branches of the vine), nipping off the buds, *pincement* (nipping off the heads of buds), pruning, stripping off the leaves, suppression of the grapes, annular incision, etc., etc. Cultivation of forced raisins: France and foreign countries.

(II) *Soil and Manures.*

(1) *Influence of the soil on the* cultivation of the vine, the quality and quantity of the products.
(2) *Geological characters* of the principal soils of the great wine-vineyards.
(3) *Influence of the various elements in the soil on the quality and quantity of the products.*—Colouration, compactness, pebbles, humidity. Iron, limestone, clay, silica, magnesia, humus. Analyses of the soils of the principal growths, and deductions therefrom.
(4) *Chemical composition of the vine at various periods of growth.*—Influence of the soil and of the stock; American and French vines, grafted vines. Quantity of materials abstracted per hectare and per year in various vineyards.
Conclusions as to use of fertilisers.
(5) *Manures.*—History of opinions as to the necessity of manuring for vines, and as to their action on the quality of the wines.
Vineyards of great yield and vineyards yielding fine wines: orientation to give to the selection of the manures.
Action of the various manures of animal origin and vegetable origin; their selection, quantity to be used. Economical conditions of production and purchase of manures in the wine-growing countries. Green manures.
Chemical manures; their rôle in viticulture; action of the various elements (potash, phosphoric acid, nitrogen, lime, plaster, sulphate of iron, etc.) on the vegetation, the production of timber, the quality and the quantity of the wine. Formulæ of chemical manures. Rotation of the manuring for the intensive culture and the culture of great vineyards. Clays and composts.
Application of the manures, spreading out, period, purchase.

(III) *Annual Cultures.*

(1) Autumn work in cold, temperate, and warm countries. Instruments.
(2) Winter work.
(3) Work in spring and summer in the various districts. Instruments.
(4) Summer irrigation in the warm countries; its importance and influence.
(5) Annual expenses of culture and their distribution in various vineyards.
(6) Vintages. Conditions to be sought for in the maturation of fruits for the production of various wines. Technical characters of the industrial maturation. Tests. Influence of the various component elements of the must on the constitution of the vines of the Southern or Northern regions; conclusions. Estimates from the standing crop.
Organisation of the vintage in the various French vineyard regions. Apparatus and means of collecting the crop and transporting it; distribution; net cost per hectare and per hectolitre. Special organisation in the large vineyards, and in the warm countries. Refrigerating systems. Placing in cellar, fermentation.
Crop of table-raisins; packing, expedition, conservation.

(IV) *Creation and Reconstruction of Vineyards.*

(1) Influence of the phylloxera crisis. New conditions for the creation of a vineyard.
(2) History of the phylloxera disease; its significance.
(3) Action of phylloxera upon the roots. Evolution of the phylloxera. Biology of the insect considered in its relation with the conditions existing in virtue of cultivation. Phylloxera-lesions. Their importance. Deductions.

(4)

(4) Resisting powers of American vines. Influence of soil, climate, species.
(5) Comparative value of various processes in the struggle against phylloxera. Conclusions.
(6) Treatment by extinction and the Balbiani process. Curative treatment. Insecticides. Submersion. Sand. Carbon disulphide and dissolved sulphur. Potassium sulphocarbonate.
(7) American vines. Study of species.
(8) Creation of varieties and stocks by hybridisation. Seeds. Selections of cuttings and graftings; cultural importance.
(9) Graftings, and direct production. Hybrids.
(10) Asexual hybridisation.
(11) Chlorosis and adaptation. Conclusions as to selection of graft-bearers for various soils.
(12) Vine cuttings and nurseries.
(13) Grafting, affinity, system of graftings, nurseries, graft-cuttings, selection.
(14) Layering. New conditions involved in reconstruction.
(15) Plantation of vine. Preparation of the soil; work; drainage. Spacing in various districts. Grouping of the vineyards. Periods for planting. Sketch of plantation according to various systems: its execution. Care to be given to young plants.
(16) Cost of creation, and of culture in various wine-growing districts. Study of hand-labour and the social conditions of the vigneron in various districts.

Diseases of the Vine.

(1) General and economic considerations. (2) Physiological maladies. (3) Meteorogical disasters. (4) Bacterial diseases. (5) Cryptogamic diseases. (6) Diseases due to animal parasites. (7) Treatment of diseases and culture.

15. *Conférences on Viticulture.*—Besides the lectures above referred to, there are a series of "*Conférences*" on pruning, grafting, diseases of the vine, etc. The programme is as follows:—

Conferences on Viticulture.

(1) ***Pruning.***—Utility of pruning. Principles of pruning. Various prunings, practical considerations concerning the choice of methods.
(2) *Grafting.*—History of grafting, its actual rôle. Preparation of the scion or graft and of the stock. Choice of a graft. The various grafts: English cleft-grafts, plain cleft-grafts, shoulder-grafts, etc. Grafting machines. Nurseries.
(3) *Stocks.*—Ampelography and characterisation of the most extensive stocks; general considerations concerning their use.
(4) *Diseases of the Vine.*—Practical preparation of solutions. Their use. Immediate signs of the diseases.

Excursions are made to the vineyards in the environs of Paris, and practical demonstrations of pruning and cultural operations are given on the ground. Besides this, an excursion is made to a great French vineyard.

This completes the course on viticulture. It need hardly be mentioned that there is, of course, a special laboratory in connection with viticulture.

16. *Colonial Culture.*—In order that the general character of colonial culture may be understood, there is a course of 15 lectures, the programme of which is hereunder:—

Colonial Cultures. (15 Lectures.)

1*st Part.*

What constitutes Colonial Culture.

What distinguishes colonial from metropolitan agriculture. Its proper influence on the development of the wealth of the colonies and the metropolis. Interest that it presents for those who desire to devote themselves to it.

Relations of the mother country and the colonies.

Customs tariffs. Facilities given to agricultural colonisation. Organisation of agricultural services in the colonies. Experimental gardens and the colonial garden; their rôle and relations.

Present situation of colonisation in the French possessions. Difference between commercial and agricultural colonisation.

Exploitation of natural products and cultural production.

Organisation of the exploitation in the Colonies.

Agricultural concessions. General conditions of their grant. The societies for exploitation. Their various modes of organisation. General conditions which must control their organisation and progress.

General conditions which govern cultivation in the Colonies.

(1) Climatic conditions. (2) Economic conditions. Influences which these exert on the choice of cultures to be carried out and methods to be followed.

Characteristics of Colonial Culture.

Study of climate. Temperature, humidity, light. Influence of these agents on vegetation. Differences in practical cultivation depending on the distribution and action of these agents.

Plants cultivated for living, for industrial use. Rotation of crops, and dressing by means thereof. Multiplication of plants. Reasons for methods of improvement of selection, of hybridisation, etc. Transformation of plants by culture.

Improvement of Soil.—Selection of plot and location of a plantation. Forest lands and plain, herbaceous lands. Total and partial clearing. Study of the soil; analysis. Creation of an oasis. Hydraulics in so far as application to the colonial culture is concerned.

2nd

2nd Part.

Study of the French Oversea Possessions.—Colonies and protectorates. Population and exploitation colonies. Rules which should govern the organisation of exploitations in each case. Economic régime of the colonies. Customs duties. *Octroi de mer*, etc., on entrance into exit from the colonies. Rights affecting the importation of colonial products into the mother country.

Administrative organisation of the Colonies.—Their economic machinery. Methodical study of the colonies with reference to their climate, their agricultural productions, and their administrative organisation.

Cultures which may be undertaken.—Summary study of these principal cultures. Natural products, and what can be obtained therefrom.

The African Colonies.—Algeria, Tunis, Senegal, Soudan, Guinea, Ivory Coast, Dahomey, French Congo, Madagascar, La Réunion, Coast of the Somalis.

Colonies of Asia, America, and Oceania.—Indo-China, Guiana, Martinique, Guadeloupe, New Caledonia, Possessions in Oceania.

The course gives a fairly complete view of what is possible in colonial enterprise.

17. *Comparative Agriculture.*—The comparative study of agriculture is calculated to broaden the conceptions of its significance for the world at large, and to widely qualify the scientific agriculturist. The course is one of 30 lectures, covering the ground indicated in the following programme :—

Comparative Agriculture. (30 Lectures.)

Aim of the Course.

Study of Agriculture in the various natural regions of France, and in the principal foreign countries.

1st Part.—France.

Different factors, according to which the systems of culture vary—*soil, climate, economical conditions.* In France the soil is the preponderating factor. The soil, or, rather, its geological constitution, determines the various systems of culture found in the very numerous and varied natural regions of France. Hence geology should be taken as a basis for the agricultural study of the various natural regions of France.

Method pursued in the study of comparative Agriculture of the various natural regions of France.

(I) Rapid survey of the geology of the natural region studied.
(II) Régime in respect of water, springs, phreatic sheets of water, etc. ; consequences thereof—(1) On the group of habitations (villages, isolated farms) ; (2) on the scheme of culture (drainage, irrigations).
(III) Nature of the agricultural lands of the region ; their physical and chemical composition ; result of the analyses of lands ; results of the experimental fields established in order to discover the qualities of the lands ; discussion of results.
(IV) The climate of the natural region studied in particular ; temperature, rainfall, etc.
(V) Special economic conditions of the region ; means of communication ; proximity to great centres of population ; local industries.
(VI) Agricultural statistics of the principal products of vegetable and animal origin of the country.
(VII) Systems of culture in the country ; *history* of these ; their *raison d'être* formerly and at present ; the systems discussed.
(VIII) Detailed monographs of exploitations may be cited as examples of suitable systems of culture. Improvements necessary.

In following such a programme, the natural regions of France are studied, those which present the same geological constitutions being treated together.

Soils of natural regions formed by the decomposition of primitive rocks—granite, gneiss, etc.—and by decomposition of the primary or palæozoic group.

(1) The central group of France (La Lozère, La Correze, Limousin, Black Mountain, the Cevennes, Lyonnais, Beaujolais, Morvan).
(2) Brittany.
(3) Vendée, Maine, the Norman Bocage.
(4) The Ardennes, the Pyrenees, and the Alps.
(5) Les Maures, Esterel, Corsica.

Natural regions, where the earths are formed from the decomposition of volcanic rocks—trachytes, basalts, lava, etc.

Auvergne, Aubrac, Mezenc, and Velay.

Triassic regions.—The Vosges and Lorraine.

Regions where the Jurassic system prevails :—

(1) The herbage of the lias of Basigny, of Charolais, of the Valley of Germigny.
(2) The Bessin, the plain of Caen, the Auge region, etc.
(3) The Champagne of Sarthe, Belinois.
(4) The plain of the Charentes and of the Vendée.
(5) The Berry.
(6) Burgundy.
(7) Region of the East: Plateau of Langres, of the Haye, the Barrois, the coast region, the Wœvre, etc.
(8) Jura.
(9) The Causses.

Regions

Regions where the Cretaceous System prevails.

(1) In the basin of the Rhône; chain of the Alpes, secondary chains, the Alpes of Provence. The Garrigues.
(2) The Paris basin; Champagne; the Sancerrois.
(3) The Bray region; the Boulonnais.
(4) Perche, Touraine, Thiérache.
(5) La Champagne; Pouilleuse.
(6) Charentes, Perigord.

Natural regions where Tertiary and Quarternary rocks prevail.

Paris Basin—
(1) The region of Caux, Norman Vexin, Roumois, Louvaine.
(2) Picardy, Artois, the industrial region of the North, the plain of Laon, Soissonnais, Valois, Multien, etc.
(3) Brie, Hurepois, Beauce.

South of the Loire—
(1) Sologne, Brenne, Limagne, the plain of Forez.

Basin of the Saône and Rhône—
(1) Bresse, Dombes.
(2) Dauphiné, Graisivaudan.
(3) The valley of the Rhône, Paluds, Crau, Camargue.
(4) Bas Languedoc, Roussillon, Cerdagne.

Basin of the Garonne—
(1) Aquitaine.
(2) Béarn, the Basque region, Chalosse.
(3) The moors of Gascony.
(4) The Gironde, etc.

Polders and peat bogs.
Résumé of France. Conclusions.
Diversity of the natural regions of France: suitability for an infinite variety of products; specialisation of the different natural regions; their solidarity.

2nd Part.

Agriculture of the principal Foreign Countries.

(I) *Method followed in this study for each country.*—Rapid review of the geography, especially of the physical geography, of the country, its principal natural regions, their comparison with the natural regions of France, the character of which is most similar.
(II) Economical conditions of the country studied: régime in respect of property. Mode of exploitation. Means of communication, principal markets.
(III) Statistics of the agricultural products of the country · importation; exportation; products which create competition with others; markets for our products.
(IV) Rapid survey of the agriculture of the principal natural regions of the country, their particular features.
(V) (1). Actual tendencies of the agriculture of any country. Great Britain and Ireland. Belgium. Holland. Denmark. Sweden and Norway. Germany. Switzerland. Austria. The North of Italy. Hungary. Bulgaria. Servia. Roumania. Russia, Siberia. The United States, Canada. South America, The Argentine Republic, Brazil. Australia, the Indies.

18. *Course in Arboriculture.*—The course in arboriculture consists of 12 lectures, or rather 12 theoretical *conférences*, and six demonstrations in the field. It is arranged as follows:—

Arboriculture.

Definition and division of fruit-tree arboriculture. Importance of the production of fruit in France and Algeria; annual crop. Importation and exportation.
Classification and enumeration of the principal kinds of fruit cultivated in France.

(I) *Multiplication and production of trees in the nursery.*

Utility of a nursery. Principal nursery centres in France.
Creation of a nursery.—Selection of the site; establishment of enclosures and shelters; division of the plot: preparation of the soil.
Natural multiplication.—Seed plot; harvest, selection and preparation of seed; conservation and testing, selection and preparation of the soil; sowing; care in order to assure success in the seed-plot.
Advantages and inconveniences of natural multiplication.
Artificial multiplication—
(1) Grafting: Definition and advantages. Influences of the stock and of the graft. Conditions of success. Different kinds of graftings: (i) by approach and by non-detached branch; (ii) by detached branch; (iii) by detached bud.
(2) *Layering.*—Definition. Advantages. Conditions of success. Description of various modes of layering; simple and compound layers.
(3) *Cuttings.*—Definition. Advantages. Conditions of success. Description of various methods; branch, root, and leaf cuttings.

Transplantation into the nursery. Formation of trees. Transplantation of trees.

(II) *Creation of the Fruit Garden.*

Definition of fruit gardens, fruit and kitchen gardens, and orchards.
Creation of the fruit garden.—Selection of site; climate, situation and aspect. Nature of the soil and subsoil; extent. Enclosures: walls, fences, hedges, drains. Establishing of enclosure walls and of partition walls.

 Division

Division and arrangement of the plot for commercial and for private cultivation. Laying out of fruit and kitchen gardens.—Preparation of soil and sub-soil; making wholesome, lighter, improving and dressing, etc.

Plantation.—Selection and preparation of trees; period for planting; dressing, spacing; distances to be observed; care in order to secure the underpropping.

Physiological ideas on which pruning is based.—General principles of pruning for the formation of wood to obtain branched wood; pruning of prolongations. Application to fruit trees; mode of increasing the beauty of the fruits.

The form to be given to the trees.—Tree forms; voluminous or round forms; plane or flattened forms. Examination of the various forms; high stems and half stems, pyramidal, spindle, and various other forms. Circumstances deciding the choice of form.

Establishment of espaliers and contre-espaliers.

(III) *Cultivation of special kinds of fruits.*

The Pear.—History. Climate. Situation. Sun. Multiplication and selection of stocks for grafting. Varieties to be planted. Placing. Formation of the wood. Pruning for fruit. Summer operations. Various cares. Maintenance. Restoration and rejuvenation of trees. Noxious insects and diseases.

Crop and conservation of fruit.—Construction of fruit-loft for the preservation of fruits.

The same system, more or less extended or restricted, is followed for the following fruit-trees:—

Apple. Peach. Cherry. Plum. Apricot. Almond. Red-currant. Raspberry.

Cultivation of the apple for cider.—Multiplication and rearing in a nursery. Selection of cider varieties of high density. Sun, aspect and position which are suitable for the cider-apple. Plantation in line and *en plein*. Varieties. Laying out of the orchard. Planting.

Selection of trees. Period for planting. Care as to underpinning.

Maintenance: Ploughing and dressing; pruning and lopping; props and defences. Diseases and noxious insects.

The crop and its preservation.

Demonstrations on the ground.

(At the kitchen-garden of the National School of Horticulture of Versailles).

Various kinds of grafting, of cutting and layering.

Study of the laying out of gardens; Installation of espaliers and of contre-espaliers; Examination of the various forms given to the wood of trees.

Planting in the open air, in espalier, in moist ground.

The winter pruning of the various fruit-trees.

Summer operations: *pincement* (nipping off the heads of buds), green pruning, tying up, stripping, clearing the fruit; protection of fruits *de luxe*. Penthouses.

Application of insecticides and treatment of diseases.

Cultivation of asparagus, artichokes, and strawberry-plants.

Beds for the cultivation of mushroom, of endive, chicory, etc.

Visit to green-houses and hot-houses for the cultivation under glass of grapes, peaches, cherries, strawberries, pineapples, etc.

Multiplication, plantation and pruning of early and ordinary melons; setting the beds; frames, mats, etc.

Cultivation of the fig in Paris: Layering plantation, pruning, shelter.

The thoroughness of the course will be seen from the outline given.

19. *Aquiculture.*—Aquiculture is a term used very much in the sense we use pisciculture. The course is one of 15 lectures, the programme of which runs about as hereunder.

Aquiculture. (15 Lectures.)

Definitions. Importance of fish as a food for human beings. Statistics. Present condition of Pisciculture in France and in foreign countries.

General ideas concerning the organism of the fish, especially as regards nutrition and reproduction. Principal species for pisciculture. Habits. Migration. Classification.

Natural pisciculture in ponds and lakes. Nature of the bed. Temperature of the water; its composition. Aquatic flora. Creation of fish-pond, Spawning beds. Fishing.

Ponds for carp, etc., carp trade, Winter fish-ponds. Trout-ponds.

Fresh-water lakes. Attempts at natural pisciculture in the lakes of Auvergne, Italy, etc. Pisciculture in streams and rivers. Spawning beds. Reserves.

Causes of the diminishing of fish rivers. Attempts at restocking,

Artificial pisciculture. History. Theory. Artificial fertilisation.

Study of the various methods of artificial fertilisation. Transport of the fertilised spawn.

Incubation. Hatching apparatus. Attention to be given to the spawn. Supply of food-water to the apparatus.

Small fry. Ponds for same. Their feeding. Attention to be given. Diseases. Their transport.

Principal pisciculture establishments in France and in foreign countries.

Diseases and enemies of fish.

Crayfish. Disease. Restocking.

Oyster-culture. History. Culture. Diseases. Principal oyster centres.

Legislation.

20. *The horse and its care.*—This subject is known in France as *Hippologie*. The course consists of 10 lectures according to the programme hereinafter. It may be mentioned that the chair was created only at the end of 1883.

Hippology.

Hippology. The Horse.

Programme of the Course. (10 Lectures.)

I. *Aim of the lectures.*

Initiation into the practical matters; hippology; exclusive study of the horse as a motor agent.

History of the horse. Ancient and modern times; its rôle in industry, commerce, and the army. Influence of mechanical traction, railways, automobiles, etc., on horse-breeding.

Anatomical, physiological, and mechanical generalities. Conformation and capacity of work; the animal machine; skeleton, muscles, cavities protecting the viscera and the organs; laws of mechanics; levers, equilibrium, proportions and articular angles; weight of animals; young age, adult age, and old age.

II. *External form.*

(1) Divisions of the body; examination of the head; conformation; expression; form; regions; movements and directions; examination of the body; neck and shoulders; withers; back; loins; haunch; rump; tail; breast; veins of the fore leg; girth; belly; ribs; flanks, etc.
Examination of the thorax, abdomen, and pelvis.

(2) *Examination of legs.* Fore legs; hind legs; examination of each, good points, imperfections, aplomb and proportion, defects, diseases.

III. *Descriptions. Ordinary and zootechnical.*

(1) *Age of horse.* Study of the teeth; three periods corresponding to the periods of the development of the body.

1st period: Young horse as far as its complete development.
2nd period: Prime or adult age.
3rd period: Enfeeblement through age; irregularities of dentition; natural and artificial.

(2) *Size.* Methods and instruments for measuring.
(3) Colour, or coat. Coats properly so-called; their varieties according to the colour of the hair; special features or secondary characters of the coat; peculiarities of the head and legs.
(4) Date of the description.

IV. *Farriery. Aim. Teaching.*

History; importance; results of shoeing from a social point of view; anatomy; conformation of the foot and physiology of locomotion.

Manual of shoeing; French and English; hand-shoeing; mechanical shoeing; general rules regarding shoeing; foreign shoeing; shoeing for the different services; Lafosse, Charlier, orthopædic, chirurgical shoeings, etc.; shoeing of the ass and the mule, shoeing of the ox. Iced shoes for all animals.

V. *Feeding: its history and bibliography.*

Study of the elements constituting the animal body and constituting fodder; nitrogenous, fatty hydrocarbonate, and mineral matters; discussion upon the influence of these different principles; methods for the determination of the composition of the rations; experimental or practical method, scientific method.

Nutritive equivalents. Digestibility.

VI. *Special foods for the horse.*

Oats.—Culture; qualities; means of estimating their practical and scientific value; productions, French oats; crops and consumption; foreign oats; crops and consumption; comparison between indigenous and exotic oats; commerce in oats, frauds, custom duties, and grants.

Conveyance by boat and by railway; general, special, communal, and international railway-tariffs.

Conservation of oats, their changes. Ensilage.

Cleaning. Digestibility.

VII. *Substitutes for oat-feed.*

Concentrated foods; maize; barley; rye; wheat; millet; buckwheat; beans and horse-beans; peas and lentils; details as for oats.

Other substances which may form part of the ration; bread; oil-cake; bran; barley and oatmeal; sugar substances, molasses; animal substances; meat; milk; eggs; composition and mode of distribution of these commodities.

VIII. *Fodders.*

Hay from natural and artificial meadows. Quality, botanical and chemical composition; means of estimating, consumption; transport; compressing; different systems of compressing; railway tariffs; changes in hay.

Chaff. Details as for hay.

IX. *Substitutes for hay and straw.*

Aftermath; lucerne hay; sainfoin and clover; furzes; alfa-alfa; carob-beans; roots and tubercles; carrots, parsnips, Jerusalem-artichokes, beet-roots, etc.

Condiments; sea-salt; aromatics; phosphates and carbonates, arsenic, etc.

Drinks; water, quality and temperature; mode of administration.

X. *Composition and determination of the ration.*

Generalities: Ration formerly determined by blind trial by agriculturists and by post-masters.

Scientific ration determined according to age, the work, and character of the ration itself.

Maintenance, transport and working rations; role of proteid, fatty, saccharine, carbohydrate and mineral matters.

Method of weighing; experiments of Baudement, of the great transport companies, and of the Minister for War.

Scientific

Scientific calculation of the ration, according to the chemical composition and the digestibility of the aliments, and according to the weight and the work of the animals.
Substitutions in the ration; preparation and distribution of the food.

XI. *Stables.*

External and internal arrangements; ceiling; ground; openings; aeration; ventilation; temperature.
Stable furniture.
Types of stables; industrial, military, *de luxe*, field.
Various litters according to localities and resources.

XII. *Care of horses.*

Grooming; bathing; clipping, etc.
Harnessing: Harness for saddle-horse and pack-horse; for the light and heavy draught-horses; collar and breast collar, various collar models, etc.

21. *The practical teaching of Agronomy.*—It will be seen from the preceding outlines of the various programmes, that the Agronomical Institut affords an opportunity of the widest possible culture in the subjects it undertakes to teach.

The following supplementary remarks are translated from official papers:—

The law which restored in 1876, the "*Institut National Agronomique*" required that a domain should be added to the establishment, so that the pupils who, in the amphitheatres and laboratories of the Institute, receive higher theoretic instruction may, at the same time, profit by a really practical education. This in order that they may not be at a disadvantage as compared with young men educated in merely practical establishments, at least as regards the agricultural life and in the competitions.

The city of Paris possessed within the boundaries of the redoubt of Faisanderie, at Joinville-le-Pont, about thirty hectares in plots, and also structures which formerly served for a "*vacherie*," and several sheep-folds. On the initiative of the first Director of the "*Institut Agronomique*," M. Tisserand, the ground and buildings were rented for a period of 18 years, and this was continued until 1901.

In the old vacherie, chemical, vegetable-biological, general physiological, and agricultural-technological laboratories were equipped and set up. A large experimental field of about 3 hectares, with plant-beds, a green-house, stables, a sheep-pen, a piggery, etc., was available for the practical education of the students. These were so much the more valuable, since the "*Institut Agronomique*" was prior thereto confined within very narrow limits at the Conservatoire des Arts-et-Métiers, and it had not sufficient laboratory accommodation. In fact the first generation of agronomic engineers were trained at Joinville, and important researches were effected there.

But, from the year 1889, a series of circumstances occurred to diminish the efficacy of the teaching on the domain of Joinville. Great laboratories were established in Paris itself; the professors the chiefs of works, and the students were more inclined to work at the seat itself of the course, than in a more remote place. This and other causes led to a change. Suffice it to observe that in January, 1902, the domain of Thenil-Maintenon, of 281 hectares at Noisy-le-Roi, was placed at the disposal of the "Institut Agronomique" as an experimental field.

The pupils under the guidance of the Professors and *chefs de travaux* assist in all the operations in "*grande culture*," *under conditions exactly similar to those which yield profit*, and not merely under conditions which demonstrate what is possible agriculturally, when no regard is paid to expense.

There are of course also purely experimental researches.

22. *Laboratories annexed to the "Institut Agronomique."* The laboratories annexed to the "*Institut*" are—

(1) Seed-testing station (created in 1884).
(2) Station for trials of agricultural machinery (1887).
(3) Laboratory for fermentation experiments (1888).
(4) Station for vegetable pathology (1888).
(5) Entomological Station (1894).
(6) Laboratory for viticulture and œnology.
(7) Experimental Station for agricultural hydraulics.

Comment on the value of these is unnecessary.

23. *Analyses of seeds.*—The seed-testing station is one of great practical value. At one time seed was bought and sold without any sort of guarantee whatever. All this is rapidly changing throughout Europe. About 22,000 analyses were made at the station up to the end of 1902. Vendors of seed now guarantee source, purity, germinative value, etc. A tariff is fixed by the Minister for Agriculture as follows:—

A. Tariff payable by Cultivators.

(a)	Analyses of grain other than meadow grasses	1 franc.
(b)	Analyses of meadow-grass seed	2 francs.

B. Tariff payable by houses not officially under the control of the Station.

(a)	Determination of identity	3 francs.
(b)	" purity	2 "
(c)	" germinative faculty	3 "
(d)	Investigation of the cuscuta...	1·50 "
(e)	Complete analyses of seed other than meadow-grass	4 "
(f)	Complete analyses of meadow-grass seed	5 "

C.

C. Tariff payable by houses officially under the control of the Station.

(a) Analysis executed for the personal information of the House:

First 40 analyses	100 francs.
Each subsequent analysis	2 ,,
Determination of the cuscuta	1 franc.
(b) Check-analyses demanded by agriculturists, by way of verification of guarantees given by vendor, are payable uniformly at one price, viz.	1 ,,

It may be mentioned that the station lends its assistance to Algerian agriculturists who undertake the cultivation of indigenous wild plants.

24. *Machine Testing.*—The machine testing embraces:—

(i) The mechanical return of the machine.
(ii) Quantity and quality of its work.
(iii) Cost of working.
(iv) Construction of machine.
(v) Approximate wear and tear.

Inventors, constructors, or their representatives, may submit their machines, they are tested in agricultural exploitations, or in factories, etc., and the results are officially communicated to the interested parties. Thus the report is a public document.

The station even undertakes tests of resistance of material, etc., so that a mechanic may improve his work or device, and bring it to a more satisfactory state.

25. *Diploma of the Agronomical Engineer.* The "*Institut Agronomique*" issues to the students who satisfactorily pass through its course a diploma certifying his place and percentage. The following is the form of the diploma:—

Republique Française.

Ministère de l'Agriculture.—Institut National Agronomique.

Diplôme d'Ingénieur Agronome.

Le Ministre de l'Agriculture,—

Vu la loi du 9 août 1876, portant création de l'institut national agronomique. Vu l'arrété ministeriel du 18 fevrier 1892, qui a créé le titre d'Ingénieur agronome ; Vu la deliberation du Conseil de l'Institut national agronomique, en date du , de laquelle il résulte que M né à , le a satisfait d'une manière complète a toutes les épreuves das examens prescrits par le règlement qu'il a été classé le sur élèves français, et qu'il a obtenu points sur un total de soit p. %.

Accorde à M le Diplôme d'Ingénieur agronome.

Fait à Paris, sous le sceau du Ministère de l'Agriculture, le Le Ministre de l'Agriculture, Le Directeur de l'Agriculture,

Signature de'Impétrant

Delivré par le Directeur de l'Institut agronomique sous le numéro d'enregistrement .

Enregistré au Ministère de l'Agriculture,
le 189 , sous le No. .

The above is the form of the Diplôme d'Ingénieur Agronome.

26. *Conclusions.*—The instruction given in the Institut National Agronomique of France is professional in the highest sense of the word. Based upon a sound preliminary education, testified by the examination conditions of admission, it produces well-informed agriculturists and agricultural engineers. The whole genius of the teaching is scientific ; and it is not elementary and half-understood science, because the students have been soundly prepared before entry. It is this appreciation of the immense value of science to practical agriculture that we need to recognise, and of the value of that training which awakens the mind to perceive conditions of which advantage may be taken in agricultural exploitation.

The grade of teaching is the highest. The following points may be noted:—

(1) It is, so far, impossible, with the machinery available in the State, to give a course of agriculture of the character given in the Institut Agronome.

(2) The establishment of a Chair in Agriculture would help somewhat, but would not even then allow of teaching of the order indicated, on account of insufficient preliminary education in the secondary schools.

(3) The training is desirable, not only for those who professionally advise on large schemes of agriculture, but also for those who carry it out on a large scale.

CHAPTER XLVI.

CHAPTER XLVI.

Agricultural and Forestry Education in American Universities.

[G. H. KNIBBS.]

1. *Introduction.*—In Chapter XXXV, Relating to the technical teaching in the higher educational institutions of the United States, it was noticed that a large number have courses in agriculture. The provision for agricultural education in the *Universities* of the United States will form the subject of this chapter.

2. *Berkeley College of Agriculture, University of California.*—The four years' course in agriculture at the Berkeley College is based on elements of a general character, *i.e.*, including subjects of general culture; and its chief aim is to combine the direction of the technical with the general training of the student. Previous experience of farm life and work is regarded as a valuable preparation for University studies in this course. The following curriculum will afford an indication of the character of the work undertaken:—

PROGRAMME OF COURSE.

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
Freshmen Year.		
Mathematics—Elements of Analysis, with applications. A practical course in algebra, analytic geometry, and the elements of differential calculus	5	5
Elementary Course in Physics—Hydrostatics, heat, light, sound, mechanics, magnetism and electricity	3	3
Chemistry—(1) Inorganic	3	3
(2) Laboratory: Experiments	2	...
(3) Laboratory: Qualitative Analysis	...	2
English—General History of English Literature	3	3
Military Science—Two exercises each week	½	½
Physical Culture	...	...
Totals	16½	16½
Sophomore Year.		
Physics—General Course, including lectures and recitations, with experimental illustration and assigned problems; properties of matter, heat, sound, light, magnetism and electricity, treated with reference to principles which underlie measurement in the Physical Laboratory, and other applications	3	3
Botany—		
Fundamentals of Botany. Lectures, illustrated as far as possible by means of specimens, diagrams, and preparations, designed to set forth in a general way the important facts, problems, and theories with which botanical science is concerned	3	...
General Plant Morphology. Laboratory and field practice on selected material to illustrate the general facts of the morphology and the simpler physiology of plants	...	3
English—Nineteenth Century Prose; *or*	(3)[2]	(3)
Practical Composition	(2)	(2)
French—Introductory Course; *or*	(3)	(3)
German—Introductory Course	(3)	(3)
Free Electives[1]	3	3
Military Science—Two exercises each week	½	½
Physical Culture	...	...
Totals	14½–15½	14½–15½

[1] Students intending to take Chemistry as a cognate Elective in the Junior Year must elect Chemistry (Laboratory: Quantitative analysis—Gravimetric and Volumetric) in the Sophomore Year.
[2] The bracketed numbers are alternative subjects.

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
Junior Year.		
Agricultural Chemistry—General Inorganic Course, with lectures and experiments; study of metals ...	3	3
French—Second-year French, reading and translation of novels and dramas; *or* ...	(3)	(3)
German—Schiller ...	(3)	(3)
Cognate Electives—Agriculture and one of the following:—Physics, Chemistry, Geology, Meteorology, Biological Sciences, Engineering, Irrigation ...	6	6
Free Electives ...	3	3
Military Science—Two exercises each week ...	½	½
Totals ...	15½	15½
Senior Year.		
Agriculture (Field cultures of grains, vegetables, and forage plants) and *Horticulture* (Principles and practice of fruit-growing in semi-tropical countries, with special reference to Californian conditions and methods) ...	3	3
Stock-breeding and Dairying ...	3	...
Cognate Electives:—Agriculture and one of the following:—Physics, Chemistry, Geology, Meteorology, Biological Sciences, Engineering, Irrigation ...	5	6
Free Electives ...	3	6
Thesis—An original study under the direction of the Professor of Agriculture ...	...	...
Military Science—Theoretical course:—		
(1) Lectures and Recitations on the organization and administration of the United States Army, supply and discipline of the company, military law, field-works ...	...	...
(2) Continuation of above. Preparation for war, the staff, tactics of the three arms, reconnaissance, security, marches, grand tactics, minor operations, logistics, strategy, military history, and material of war ...	1	1
Totals ...	15	15

The above lead to the B.S. degree.

3. *Special or Limited Courses in Agriculture, Berkeley.*—These courses are designed for students who do not desire to take the full course.

The following is the course of study pursued:—

Subjects.	Hours per Week. 1st Half-year.	Hours per Week. 2nd Half-year.
First Year.		
Agricultural Chemistry ...	3	3
Physics ...	3	3
Chemistry ...	3	3
Botany ...	3	3
Electives ...	3	3
Military Science ...	½	½
Physical Culture ...	½	½
Totals ...	15½	15½
Second Year.		
Agriculture and Horticulture ...	3	...
Stock-breeding and Dairying ...	3	...
Agricultural Elective (including Botany and Entomology) ...	6	6
Free Electives ...	3	6
Military Science ...	½	½
Physical Culture ...	...	...
Totals ...	15½	12½

4. *Experimental Stations, California University.*—In connection with the College of Agriculture are the "*Experiment Stations*" and "*Sub-Stations*," which make provision for systematic experimentation in the culture of the various farm products of California. The investigations include the introduction and testing of new varieties, the study of diseases of plants and animals, the repression of vegetable and animal parasites, etc. Samples sent for examination are analyzed or tested, and reported upon by letter as rapidly as the examinations can be completed. The entire technical staff of the department takes part in the experimental work. There are at present *eight stations* at which this work is prosecuted, viz: —

The *Central Station* at Berkeley, organised in the year 1875, from which all work connected with the various sub-stations is directed, where all laboratory investigations are made, and whence all official communications are sent. The University grounds, portions of which are set apart for experimental culture, are much diversified in aspect, are traversed by two water-courses, and are thus adapted to a great variety of plant life.

Four Outlying Culture Sub-Stations, intended mainly for culture experiments in the several distinct climatic regions of the State. These are—(1) The Sierra Foothill Station, near Jackson, Amador County; (2) The Southern Coast Range Station, near Paso Robles, San Luis, Obispo County; (3) The San Joaquin Valley Station, near Tulare, Tulare County; (4) The Southern California Station, on the Chino Ranch, between Chino and Pomona, Los Angeles County.

Two Forestry Stations, one at Santa Monica, Los Angeles County; the other near Chico, Butte County. The management of these stations was transferred to the University by the State Legislature in 1893. They are used for the experimental growing of trees likely to be of practical value in forestry in this State.

A *Viticultural Station*, for experimentation with phylloxera-resistant vines, near St. Helena, Napa Country, under the auspices of Mr. James Moffit.

5. *General remarks on the Berkeley Agricultural College.*—Besides the undergraduate course ending in the B.S. degree, graduate courses are arranged for those who wish to proceed to the degree of Master of Science and Doctor of Philosophy.

During the time of the Commissioners' visit, a considerable series of experiments were in course of progress, in the chemical nutrition of plants. The *library* of the University possesses about 100,000 volumes. The library and reading room of the Department of Agriculture are very liberally supplied with daily, weekly, and monthly publications (about 140).

There is a *Gallery* of Fine Art, with 75 paintings, some sculpture; the library rooms possess bronzes, etchings, portraits, about 1,400 photographs, and there is also a cabinet of classical archæology.

There is a *museum* for geology, mineralogy, palæontology, ethnology, anthropology, etc.

The *mathematical models* of curves and surfaces in plaster, thread, wire, wood, and celluloid number about 300.

The *Phænogamic Herbarium* numbers about 30,000 sheets of mounted specimens and about 10,000 of unmounted material. The *Cryptogamic Herbarium* contains about 4,000 sheets.

A *botanical museum* is being rapidly developed, and a large collection of cabinet woods exists. The zoology collections are considerable; there are about 2,000 well-determined species of beetles in the entomological collection.

Structural Geology is represented by a fine series of models, and so also is *Economic Geology*. The *mineralogical collection and models* are very complete; the Petrographical collection numbers over 3,000 slides of rock-sections, with the corresponding hand specimens.

6. *College of Agriculture, Cornell University, Ithaca.*—The provision made for instruction in agriculture at the Cornell University is of a comprehensive character, the various branches into which this subject is divided being as follows, viz.:—

(1.) *General Agriculture*, which embraces the study of wheat culture, the inspection of roads, bridges and farm buildings, hippology, including breeding, judging and scoring horses and sheep, special investigations and seminary work for advanced students, history and economics of agriculture, German agricultural reading, farm buildings. There are besides special studies for students of veterinary science, and winter courses in general agriculture.

(2.) *Animal Industry and Dairy Husbandry*, dealing with the principles of breeding, history and development, improvement and creation of dairy and beef breeds of cattle, etc., also the making of butter and cheese and the treatment of milk. Dairy-building is also taught, and poultry-breeding, feeding and management, construction of buildings, incubators, etc. There are also winter courses.

(3). *Horticulture.*—Wherein special attention is given to the evolution of cultivated plants, greenhouse construction and management, the literature of horticulture and landscape gardening, pomology, nursery and orchard practice, principles of vegetable gardening, German or French horticultural reading, handicraft and investigations. There is also a winter course in fruit-growing.

(4.) *Winter Course in Agriculture*, in which consideration is given to agriculture, animal industry, dairy husbandry, horticulture, and to agricultural chemistry, economic entomology, applied botany, poultry-keeping, and diseases of farm animals.

(5.) *The Agricultural Experiment Station*, for conducting experiments in animal and plant growth and reproduction, and in applied, comparative and scientific research and investigation, is a department of the College.

University extension lectures are also delivered, and investigations and experiments conducted throughout the State.

7. *Equipment of the Agricultural College.*—The equipment for instruction in agriculture is considerable; 125 acres of the arable land of the University grounds[1] have been set apart for this purpose. A four years' rotation is practised on the principal fields; one year of clover, one of corn, one of oats or barley, and one of wheat. A dairy of 20 cows, a flock of sheep, about 15 horses and colts, and other live stock are kept upon the farm. A four story barn provides for housing all the animals, machinery, tools, hay,

[1] The University grounds are 270 acres in extent.

hay, grain and manures, and also furnishes many facilities for carrying on investigations in feeding and rearing all classes of domestic animals. There are also five buildings with suitable yards and appliances for incubating eggs and rearing domestic fowls.

The class-room is provided with a collection of grains and grasses, implements of horse and hand culture, and various apparatus for carrying on instruction and conducting investigation.

The *Dairy Building* provides lecture-rooms, laboratories, and offices, besides two large rooms for butter and cheese making, both of which are fully equipped with modern machinery and appliances. Automatic electrical apparatus for controlling the temperature in cheese-curing rooms, refrigerator room, lockers, and bath-rooms are also provided. The whole building is thoroughly heated and ventilated, and power is furnished by a 60 horse-power boiler and a 25 horse-power Westinghouse engine.

There is an *Agricultural Museum*, which contains: (1) The Rau models. (2) Engravings and photographs of cultivated plants and animals obtained at the various agricultural colleges. (3) A collection of the cereals of Great Britain, being a duplicate of that in the Royal Museum of Science and Art at Edinburgh, presented by the British Government. (4) A collection of agricultural seeds. (5) A large number of models representing a great variety of agricultural implements.

The agricultural library connected with the College is well equipped with all variety of agricultural literature.

The equipment for the *Horticultural Department* comprises about 10 acres of land variously planted, forcing houses—which are eight in number, and cover about 6,000 square feet of ground—affording, together with the store-rooms and pits, excellent opportunities for nursery practice, and a museum which comprises two unique features—the garden herbarium and the collection of photographs—and possesses also a very large collection of machinery and devices for the spraying of plants. The collection of charts and specimens are also a feature of the museum.

The *Entomological Cabinet* contains collections of exotic and the common insects of the United States, many sets being illustrative of the metamorphoses and habits of insects. The laboratory is supplied with a large collection of duplicates for the use of students, and is equipped with microscopes and other apparatus necessary for practical work.

The *Insectary* of the Agricultural Experiment Station affords facilities to a limited number of advanced students for special investigations in the study of the life history of insects, and for experiments in applied entomology.

The equipment of the *Chemical Department* comprises all the varied appliances necessary for giving instruction to 400 students in General and Agricultural Chemistry.

8. *Entrance Conditions, Cornell Agricultural College.*—The conditions of admission to the courses are that candidates must be at least 16 years of age (or, if women, 17); must have certificates of good moral character; and students from other colleges or universities are required to furnish from those institutions certificates of honourable dismissal. And the following subjects are required, viz.:—English, History, and one of the four following divisions in history: (*a*) American, (*b*) English, (*c*) Ancient, (*d*) Modern European; plane geometry, elementary algebra, and either (*A*) Greek and Latin, (*B*) Latin and either Advanced French or Advanced German, or (*C*) Advanced French, Advanced German, and Advanced Mathematics. Students entering deficient in modern language must make up the deficiency as a part of the required work of the freshman and sophomore years. An alternate requirement instead of Advanced Mathematics may be offered in Physics, Chemistry, Botany, Geology, and Zoology.

9. *The Agricultural Course, Cornell.*—An indication of the plan of instruction followed in the Agricultural Department of Cornell University will be gathered from a study of the following programme. The course covers a period of four years, and the object aimed at is a broad and liberal education, leading to the degree of Bachelor of the Science of Agriculture (B.S.A.).

PROGRAMME OF THE COURSE IN AGRICULTURE, CORNELL UNIVERSITY.

Subjects.	Hours per Week. 1st Term.	Hours per Week. 2nd Term.	Subjects.	Hours per Week. 1st Term.	Hours per Week. 2nd Term.
Freshman Year.			*Sophomore Year—continued.*		
Botany...	3	3	Dairy Husbandry, Animal Industry	3	4
Invertebrate Zoology, Entomology...	2	3	*or*		
English ...	3	3	Horticulture...	3	3
Freehand and Linear Drawing ...	2	2	Elective ...	3–6	2–3
Chemistry ...	3	3	*Junior Year.*		
In addition to the above, the required Drill and Gymnasium must be taken.			Political Economy ...	3	3
			Elective ...	12–15	12–15
Sophomore Year.			*Senior Year.*		
English ...	3	3	Applied Agriculture ...	6	6
Physics ...	2	2	Farm Buildings ...	1	1
Agricultural Chemistry ...	4	4	Thesis ...	2	2
Physiology, Domestic Animals ...	...	3	Elective ...	6–9	6–9

The balance of the course is elective.

The *thesis* must represent some phase of the student's principal line of work during the later years of his course, the subject of which must receive the written approval of the Director of the College, and, with such approval, must be left with the Registrar.

Students receive instruction also in other colleges and departments, for example—Botany, Freehand Drawing, Physics, Political Economy, Physiology, Vertebrate Zoology, Hygiene, Mathematics, French, German, etc., Geology, Veterinary Science, Civil Engineering, and Mechanical Engineering, the last four being elective.

There is advanced instruction given in Agricultural Science for the purpose of preparing men for the office of teachers and experimenters, and if successfully followed will lead to the degree of Master of Science in Agriculture and to Doctor of Philosophy.

There is a *Special Course* for students who desire to avail themselves only of the technical and practical instruction in modern scientific agriculture. There are also winter courses in agriculture and dairy husbandry for those who can only attend the University during the winter months.

10. *Winter Courses, Cornell.*—The winter courses in *Agriculture* are open to anyone of 17 years of age, or over, without formal examination. Candidates for admission have simply to satisfy the Director that they have sufficient preliminary education to profit by attendance. Students may elect one of the following lines of study, viz. :—

Prescribed.	Hours per Week.	Elective.	Hours per Week.
Agriculture	5	Entomology	2
Horticulture	2	Botany	2
Animal Industry	2	Dairy Husbandry	2
Agricultural Chemistry	2	Poultry-keeping	2
		Political Economy	1
		Diseases of Farm Animals	1

Two hours per day practice in educational work in barns, dairy-houses, forcing-houses, and laboratories is given.

The winter *dairy courses* are given with the object of fitting students for conducting factories, by lectures and recitations, and by actual practice in the creamery, cheese factory and dairy laboratory, the apportionment of time being about—

Lectures on milk and its products	2 hours per week.
Lectures on subjects relating to dairying	10 ,, ,,
Practice in cheese-room, twice a week	4 to 6 hours.
Practice in butter-room, twice a week	4 to 6 ,,
Practice in dairy laboratory, twice a week	2 to 4 ,,
Problems and book-keeping	2 hours per week.

The tuition is free, but there are incidental fees as follows :—

Special, post-graduate, 3rd and 4th year students	$7.50 (about 30s.)
New York winter course in agriculture	$5
,, ,, ,, ,, (dairy husbandry branch)	$12.50
Winter dairy course, students	$15
Winter course for students not belonging to New York State	$30

For laboratory work there are deposits required varying from $1·50 to $10 (about 7s. 6d. to £2) per term.

11. *Course in Forestry, Cornell University.*—The New York State College of Forestry, established by Act of the State Legislature in 1898, authorised the trustees of Cornell University "to create and establish a department in said University to be known as, and called, the New York State College of Forestry, for the purpose of education and instruction in the principles and practices of scientific forestry." An authorisation was given to establish a demonstration forest of not more than 30,000 acres in the Adirondacks. *Although a State institution, the College is administered by the trustees of the University.*

Notwithstanding the enormous wealth of the United States in timber, the economic folly of the destruction of forests without any adequate provision for reafforestation has been recognised by the Government.

The scheme of instruction in the Forestry College of Cornell leads to the degree of *Forest Engineer*, through a four-year course. The spring courses of the Junior and Senior years, however, consist mainly of practical work in the College forest.

Tuition is free to students of the New York State; others are charged 100 dollars per annum. Beside the regular course there is a synoptical course for students in political economy, and for others who desire to know something of forestry as a matter of general education; and there is a one-term course for special students, farmers, lumbermen, and young men who wish to become foresters or manage their own woodlands more intelligently.

The field work consists of short excursions to forests, milling and wood-manufacturing establishments, visits to logging camps; and an entire spring term is spent in practice and field work. The latter includes :—

(a) *Exploitation and Surveying.*—Inspection of lumber camps, logging operations, transportation methods and mills, laying out and constructing roads, dividing and marking forest areas.

(b) *Silviculture.*—Inspection of, and participation in, planting; sowing and nursery work, making improvement cuttings, and marking out for thinning and for natural reproduction.

(c) *Mensuration and Valuation.*—Tree-measurement and studies of the rate of growth; timber estimating.

(d) *Forest Description and Regulation.*—Gathering data for working plans, and elaboration of such plans for given areas.

In

In addition, ample opportunity is given during the freshman and sophomore years for field work in Botany, Entomology, Geology and Surveying.

During the spring term in the College Forest, the courses on Fish Culture and Game Preservation are also given.

12. *Details of Graduate Course in Forestry, Cornell.*—The four-year course leading to the degree of Forest Enginneer is developed as shewn in the programme hereunder :—

PROGRAMME OF THE GRADUATE COURSE, FORESTRY ENGINEERING, CORNELL.

Subject.	1st Term.	2nd Term.
Freshman Year.		
Solid Geometry / Advanced Algebra / Plane and Spherical Trigonometry } Mathematics	2	2
Physics	5	5
Chemistry	3	3
Zoology (Invertebrate and Vertebrate)	2	2
Entomology	...	2
Botany	3	3
Meteorology (Geology)	2	...
Forestry	...	2
Sophomore Year.		
Dendrology (Botany)	3	3
Geographical Botany	...	1
Economical Zoology	3	3
Chemistry	4	...
General Geology	3	3
Pentopography (C.E.)	...	1
Land Surveying (C.E.)	...	4
Political Economy	3	3
Forestry	...	3
Junior Year.		
Botany	...	...
Physical Geography	2	...
Soils (Geology)	...	...
Fish Culture and Game Preservation	...	2
Forestry (Silviculture)	...	2
,, (Protection)	2	2
,, (Exploitation)	2	2
,, (Mensuration)	2	2

Senior Year.

Subject.	1st Term.	2nd Term. At Ithaca.	2nd Term. At Axton.
Political Economy	3	...	...
Business Law	...	...	...
Forestry (Timber Physics, Wood Technology)	4	...	...
,, (Regulation)	4	...	...
,, (Valuation and Finance)	...	2	...
,, (Administration)	...	3	...
,, (Lumber Market and Business Methods)	1	...	...
,, (History and Politics)	3	...	...
,, (Seminary, reading of German Forestry)	2	1	1
,, (Thesis)	...	4	1
,, (Practicum in Forest Regulation)	...	...	10

13. *Special Courses in Forestry.*—The synoptical course in Forestry refers to the economic nature and political aspects of the subject, and is designed especially for students of political economy, agricultural, engineering, and freshmen in the College of Forestry, to acquaint the student in a brief manner with the several subjects comprising the field of Forestry. It consists of lectures only.

The one-year course in Forestry, with special reference to silviculture is designed especially for agriculturists and others who desire a brief study of the technicalities of woodcraft and silviculture. It consists of lectures and demonstrations.

14.

14. *The Busssey Institution or School of Agriculture and Horticulture, Harvard University.*—This Institution gives systematic instruction in agriculture, useful and ornamental gardening, and land surveying, and in chemistry and natural history as applied to agriculture, horticulture, and forestry. As well as for ordinary purposes, the course may serve for the training of investigators and teachers of agricultural science, and in special cases as a school for the methodical education of youths intending to devote themselves to a country life or interested in natural history.

Candidates for admission must be at least 17 years of age and must present testimonials of good moral character. No entrance examination is required, but the instructors must receive assurance of the student's ability and earnestness in the direction of study. It would of course be an advantage to the student to pass one year at Cambridge,[1] Mass., under the Faculty of Arts and Sciences, in studying Chemistry, Geology, Meteorology, Physicial Geography, Drawing, English, French and German, or, instead of this, to pursue the courses of instruction at the two institutions in the same year—that is to say, when there are no stated exercises at Bussey, it is desirable that he should devote the time to studying at the Cambridge Institution.

The duration of the courses is four years. Students of the first year, who are candidates for a degree, must give equal attention to all the subjects of that year, but in the following year the subjects of study are more elective, in accordance with the aims of the students. The student may qualify through the four years' course for the degree B.A.S.

There are special courses given at the Institution to which no degree is attached, participation in which merely depending upon the presentation of certificates of good moral character.

The range of instruction is as follows :—

Theory and Practice of Farming :—

Selection of farms for special purposes. Soils best adapted to different crops. Location of farm buildings. Clearing land of rocks and stumps. Building of farm roads. Preparation and management of cranberry bogs. Selection of stock for farm purposes, with directions for breeding the same. Breeding and care of poultry. Construction of poultry houses. How to compost manures, and to save those waste materials of the farm which contain plant food. How to buy, mix, and apply commercial fertilisers. Preparation of the soil for different crops. Cultivation, harvesting, and marketing of crops. Fruit-growing and market-gardening.

Horticulture :—

Preparation of soils for horticultural and floricultural purposes. Management of plants, including methods of propagation. Horticultural implements. Methods of obtaining new varieties of vegetables, fruits, and flowers. Arrangement and care of flower-gardens and kitchen-gardens, nurseries and orchards. The construction and care of green-houses, plant-cellars, pits, frames, and hotbeds. Value of trees, shrubs, and herbaceous plants for ornamental purposes. Practical work in making plans and estimates for planting. Practical green-house and garden work by the student supplements the lectures.

(Students interested in the cultivation of trees and shrubs have the opportunity of seeing them grown in great variety and in large numbers for the Arnold Arboretum, on grounds adjacent to the school.)

Natural History :—

Introduction to the study of organic life. Plants and animals contrasted. The cell and its significance. The different parts of living organisms and their uses. Physiology of plants and animals. Methods of recognising weeds, grasses, and other plants, and of destroying weeds. Structure and habits of insects, and methods of combating those kinds which are injurious. Detection, habits, and prevention of smuts, rusts, blights, and mildews. Relation of bacteria to dairying. Sanitation of farm buildings. Heredity, variation and development. Domestication of plants and animals ; derivation of improved varieties. Cross-breeding and hybridising. Influence of insects in fertilising plants.

Mathematics and Surveying :—

Algebra, through quadratic equations ; theory of exponents ; square roots and cube roots of numbers. Plane geometry, with special attention to mensuration. Trigonometry and logarithms ; solution and areas of right and oblique triangles. Surveying, drawing plans and topographic maps of small tracts ; traversing and staking out bounds. Profile and differential levelling. Brief reports are made by the students, exemplifying the relation of the subjects taken up to their work in practical life and incidentally training them in technical expression. The field work aims to give familiarity with instruments, plans, and deeds.

Agricultural Chemistry :—

Soil, air, and water in their relations to the plant. The food of plants—manures, general and special. Chemical principles of tillage, irrigation, systems of rotation, and of special crops and farms. Description of various crops and methods of treating them Comparative agriculture. The food of animals ; simple and mixed rations Discussion of the values of different kinds of fodders, of the means of determining fodder values, and of the methods of using fodders to the best advantage.

(Laboratory instruction in chemical analysis is given to students who desire it.)

This instruction is given by lectures and recitations, and by practical exercises in the laboratories, green-houses and fields, every student being taught to make experiments, study specimens, and observe for himself. The regular exercises are supplemented by excursions for studying farms, animals, and dairies. There are also field lessons for the better examination and comprehension of objects of agricultural natural history.

Although a four-year course is provided, still students may graduate at the end of the third year for the B.A.S. degree, the fourth year being merely optional. The *year* is *advisable*, even in the case of students entering the Institution well prepared ; *it is necessary*, in the case of those whose previous knowledge is insufficient, to pursue with advantage the first-year course.

The programme of studies outlined hereinbefore is for the first year, with the exception of Mathematics and Surveying ; but fuller development is given to them during the second and third years. There is no specified plan of studies laid down for the second and third years on account of the varying requirements of each student, but a wide range of advanced studies are given both at Bussey and at Cambridge from which the student may select those best befitting his aims and purposes with regard to his future agricultural career, with the advice and consent of his instructors. The following will perhaps give a general idea of the work that a student in agriculture should pursue at Bussey during his second and third years :—

Much time should be devoted to advanced study in the following subjects, viz.:—Market gardening ; fruit-growing and comparative farming, as influenced by soils and climates ; horticulture, viz., ornamental plants and landscape gardening ; natural history ; foods and feeding of cattle ; dairying and stock-raising ; land-surveying and agricultural chemistry.

At·

[1] Harvard, Cambridge, is close to Boston.

At Cambridge, geology, physiography, meteorology, road-building, and irrigation, together with advanced physics, German and French, should be studied; and it is advised that a *fourth year* should be occupied with a continuation of these studies and by research, either in Agriculture, Horticulture, Applied Zoology, or Agricultural Chemistry. A student of *Horticulture* would follow the same course, except that he would take Botany or similar subjects, rather than Geology or subjects relating to cattle.

Students who intend to become Teachers of Agricultural Science continue to study Natural History and Agricultural Chemistry at Bussey Institution during the second and third years; at the same time, they have the privilege of studying Advanced Botany and Zoology, Philosophy, Education, Scientific German, Geology, and French at Cambridge College

15. *Fees, Agricultural Course, Harvard.*—The regular fee for the academic year is 150 dollars; for half-year, 75 dollars. In the case of regular students of intellectual ability and adequate schooling the *tuition-fees are remitted on the presentation of evidence of inability to pay.* The instruction and the examinations given in other departments of the University are free to students in full regular standing; a charge is made, however, for the exercises carried on in the special laboratories.

The special Agricultural Library at the Bussey Institution, the College Library at Cambridge, and the Boston Public Library, which has a branch and office for the delivery of books in Jamaica Plain, are at the free disposal of the students.

16. *School of Agriculture, Purdue University.*—The course of study offered in this Institution is of four years' duration, and is intended to give students a thorough training in the approved principles and practices of Agriculture. This is accomplished by means of practice in the chemical, botantical, biological, physical, veterinary, and dairy laboratories on the farm proper, and by lectures and text-books. The following is an outline of the curriculum for the four years:—

PROGRAMME IN AGRICULTURE, PURDUE UNIVERSITY.

Subjects.	Hours per Week.	Subjects.	Hours per Week.
	Freshman Year.		
First Semester.		Second Semester.	
Mathematics ...	5	Mathematics ...	5
English ...	5	English ...	5
Breeds of Live Stock ...	3	Agriculture ...	3
Botany ...	4	Chemistry ...	4
Mechanical Drawing ...	6	Farm Buildings ...	5
Shop Work ...	3	Shop Work ...	9
Military Drill ...	2	Military Drill ...	2
	Sophomore Year.		
English[1] ...	4	English[1] ...	4
Physics ...	4	Physics ...	3
Chemistry—Lectures ...	2	Chemistry—Lectures ...	2
Chemistry—Laboratory ...	4	Chemistry—Laboratory ...	4
Biology ...	8	Biology ...	8
Economic Botany ...	4	Farm Engineering ...	3
Farm Economy ...	2	Economic Entomology ...	4
Military Drill ...	2	Military Drill ...	2
	Junior Year.		
First Semester.		Second Semester.	
English ...	4	History ...	4
Horticulture...	3	Stock-breeding and Feeding ...	3
Agriculture ...	3	Animal Anatomy and Physiology ...	5
Animal Anatomy and Physiology ...	5	Dairying ...	3
General Electives—		General Electives—	
Botany or Zoology or Chemistry ...	8	Botany or Zoology, or Chemistry ...	7
German or French ...	4	French or German ...	4
Special Electives—		Special Electives—	
Soil Physics, Advanced Entomology and Horticulture, Microscopic Technique...	8	Agricultural Chemistry, Advanced Entomology and Horticulture, Microscopic Technique ...	8
	Senior Year.		
First Semester.		Second Semester.	
Human Body ...	4	Geology ...	4
Psychology ...	4	History or Agriculture ...	3
Thesis ...	4	Political Economy ...	3
History of Agriculture ...	3	Thesis ...	6
General Electives—		General Electives—	
Literature, History, Chemistry, Botany, Zoology, French or German...	4	Literature, History, Chemistry, Botany, Zoology, French or German ...	4
Special Electives—		Special Electives—	
Bacteriology, Veterinary Medicine, Forestry, Live-stock, Husbandry, Agricultural Chemistry ...	8	Bacteriology, Veterinary Medicine, Forestry, Agricultural Chemistry, Live-stock Husbandry ...	8

[1] Students desiring to pursue a course in Higher Mathematics may take this study instead of English, four hours per week, throughout the year.

There

There is a two-years' course which includes, in the main, the purely agricultural subjects of the regular four-years' course and omits those of general educational value. The full four-years' course is, however, strongly recommended to students.

17. *Winter course in Agriculture, Purdue University.*—There is a winter course for students who can devote only the winter season to instruction. The course has been planned, therefore, to give the largest amount of scientific and practical information possible during the winter months, and allow the students to return to the farm for the busy season. This course requires two winters for its completion.

For men and women the course includes—(1) live stock husbandry and veterinary hygiene; (2) farm dairying; (3) soils, crops, manures, and farm buildings; (4) horticulture, economic botany, and entomology; (5) agricultural chemistry, farm sanitation, vegetable parasites, and rural law; (6) shop work in wood or iron; and (7) special lectures by stockmen, farmers, and horticulturists.

For women only, the course includes (8) floriculture; (9) household chemistry; (10) household sanitation; (11) domestic economy; (12) botany; (13) drawing; (14) studies in literature.

The instruction in this course is given mainly by lectures.

18. *Agricultural Courses in the University of Wisconsin.*—Graduate, long, and short courses and a dairy course are given, and special students are allowed to take various subjects.

The degree of *Bachelor of Science in Agriculture* is conferred on students who successfully complete the long course in Agriculture. The degree of *Master of Science in Agriculture* is conferred on *Bachelors of Science in Agriculture* who complete one year of advanced study at the University and present an acceptable thesis on a topic approved by the faculty.

19. *Long Agricultural Course, Wisconsin.*—The following will give a succinct idea of the work in the various years—four:—

Freshman Year.—Biology, 5 hours per week; German, 4; Mathematics, 3; English, 3; Military Drill, 2; Gymnastics, 2; 34 hours for the year, of which 30 are in class exercise.

Sophomore Year.—German, 3 hours per week; French, 4; Physics, 5; Chemistry, 5; Electives, 3–5; Military Drill, 2; Gymnastics, 2; 34 hours for the year, of which 30 are in class-room and laboratory.

Junior and Senior Years.—Two years in one of the following subjects:—Agricultural Chemistry, Agricultural Physics, Animal Husbandry, Bacteriology, or Horticulture, as a major study; one year in one other of the above subjects to be assigned as a minor study by the class officer.

Elective studies, approved by the class officer, sufficient to complete 120 hours of class and laboratory work, besides the required Drill and Gymnastics.

20. *Short Course in Agriculture, Wisconsin.*—This course covers two terms of fourteen weeks each, beginning the first of December each year.

First Year.—Feeds and Feeding, 28 lectures. Breeds of Live Stock, with score-card practice additional in stock judging, 28 lectures. Agricultural Physics, 49 lectures with 70 hours' laboratory practice. Plant Life, 49 lectures with 70 hours' laboratory practice. Veterinary Science, 12 lectures, with clinics. Dairying, 12 lectures. Farm Dairying and Dairy Laboratory, 72 hours' practice. A course in farm book-keeping. Parliamentary Practice, 14 lectures with drill.

Second Year.—Animal Nutrition, 28 lectures, or an equivalent in essay writing. The Breeds of Live-stock, 28 lectures, with 72 hours' practice in stock judging. Agricultural Physics and Meteorology, 52 lectures with 52 hours' laboratory practice. Horticulture, 28 lectures, with laboratory and greenhouse practice additional. Elementary Agricultural Chemistry, 35 lectures and recitations. Veterinary Science, 12 lectures with demonstrations. Work-bench and Forge, 120 hours' practice. Parliamentary Practice, 12 lectures. Agricultural Economics, 12 lectures. Bacteriology, as applied to agricultural conditions, 20 lectures.

Students completing the studies of this course in a satisfactory manner are granted short-course certificates.

21. *Dairying Course, Wisconsin.*—The instruction in dairying is divided into five courses, which are as follows:—

1. Lectures and class-room work—
   - The constitution of milk, the conditions which affect creaming and churning, methods of milk testing, the preservation of milk, etc., 20 lectures.
   - Creamery management and accounts, 16 lectures.
   - Practical cheese-making, 16 lectures.
   - The influence of bacteria in the dairy, 16 lectures with demonstrations.
   - Heating, ventilation, and other physical problems directly connected with dairy practice, 8 lectures.
   - The care and management of the boiler and engine, 16 lectures and demonstrations.
   - The feeding and management of dairy stock, 8 lectures.
   - The breeding and selection of dairy stock, 8 lectures.
2. *Milk-testing.*—This embraces instruction in the laboratory in estimating the fat and other constituents in milk, butter, and cheese by methods adapted to the factory and factory operators, 15 hours per week.
3. *Butter-making.*—Butter-making is carried on daily on the creamery plan. The student learns to operate the several forms of power centrifugal separators on the market. They attend to the ripening of the cream, churning and packing butter, carrying on all the operations as they would be conducted in a creamery, 15 hours per week.
4. *Cheese-making.*—In this course, daily instruction is given in the manufacture of Cheddar cheese, the operations being carried on as in the regular factory, the students being required to take careful notes, and make reports upon the process.

   Special instruction is also given in the making of Swiss, Brick, and Limburger cheese, 16 hours per week.

5.

5. *Dairy Machinery.*—A two-storey building, with basement, has been provided for giving instruction in firing and caring for boilers, running engines, putting up shafting, cutting and fitting iron pipe, belt lacing, soldering, etc. This work aids the student to better understand the machines used in a creamery or a cheese factory, and to make repairs and improvements when needed, 30 hours per week.

The dairy class is divided into four sections, one of which is assigned daily to the laboratory, a second to the creamery, a third to the cheese factory, and a fourth to the shop for dairy machinery. The sections change each week, so that during the term each student receives instruction for three weeks in each of the four departments..

22. *Advanced Dairy Works, Wisconsin.*—The College is desirous of securing pupils who have had much experience in factory work before joining the College of Agriculture, and hence the following inducements are offered :—

Such students as are able to pass satisfactory examinations in the practical work of the creamery or cheese factory are advanced early in the term to the experimental dairy section, where problems connected with this branch are studied.

Advanced dairy instruction consists of the following :—

(1) Instruction on milk and its products.
(2) Experiemental investigations in butter making.
(3) Investigations in cheese production.
(4) Dairy bacteriology, viz :—

(a) A special course in the preservation of milk and cream for commercial purposes.
(b) Experimental work in dairy bacteriology.

23. *General Remarks on the Agricultural Courses, Wisconsin.*—The graduate courses offer advance students opportunity for professional training in original investigation. All contributions to knowledge of permanent value are published through the Bulletins of the Experimental Station over the name of the contributor. Besides the degrees already referred to, *certificates* are given, these being for the minor courses. Thus, students who pass through the short course in a satisfactory manner are awarded a corresponding certificate. Those who have completed their studies in the dairy school successfully, and have had two seasons experience in a creamery or cheese factory (one of which must follow the period spent in the dairy school) receive *dairy certificates.*

Resident tuition is *free*, and in the long course the fee for non-resident tuition is only 15 dollars (£3) per half-year, and the incidental fee is 10 dollars (£2). For the short course, non-resident tuition is 15 dollars per term, and incidental fee 5 dollars. For the dairy-course the fees are the same.

24. *Concluding Remarks on Agricultural Education in America.*—The following Universities have also courses in Agriculture, viz. :—Arkansas, Georgia, Illinois, Louisiana, Maine, Minnesota, Missouri, Nebraska, Nevada, Ohio, Tennessee, Vermont, West Virginia, and Wyoming, and the courses at Yale have already been given, viz., in Chapter XXXVIII, sections 44 and 45.

There are also agricultural courses in the following Colleges, viz. :—Delaware, North Georgia, Berea, Kentucky, Maryland, Rutger's College, New Jersey, Pennsylvania, and Vermont.

The characteristic of agricultural education in America is the wide provision made for all classes of students. Those who desire to profit by a thorough course, based upon a scientific foundation, are met, without, as a rule, being forced to study according to a unique plan which may not meet their special requirements; in other words, the American scheme embodies largely the German principle of freedom in choice of studies (*Studienfreiheit*).

The experimental work is generally of an excellent character, and the "Bulletins" of the Stations—*i.e., brochures*—giving accounts of research in various practical questions, are well-known to scientific readers.

A point worthy of special remark is that it is well recognised in America that some familiarity with Continental languages is essential to the scientific agriculturist, and the reading of Continental, and especially of German, research in agriculture, is regarded as educationally important.

The Commissioners visited a number of laboratories and museums specially devoted to Agriculture.

CHAPTER XLVII.

CHAPTER XLVII.

Agricultural Education in European Countries.

[J. W. TURNER.]

Introduction.—The teaching of agriculture in schools of the primary stage, and also in those covering the secondary periods, is a matter of considerable interest in all countries. The importance of the instruction, and the place given to it in the school curriculum, are particularly noticeable in France, Holland, Switzerland, and Belgium.

FRANCE.

The objective in the teaching and the value of the subject from the standpoint of French educationists are explained in Chapter IX of the Interim Report. There it is pointed out that, according to M. Combes, "the upper primary education has only subsisted up to the present day because of pupils whom *agriculture*, commerce, and industry have sent to it." Statistics show at the present time that two-thirds of the pupils enrolled in the primary schools of France follow up the agricultural, commercial, and industrial professions.

On page 95 of the Interim Report it is pointed out that the aim of the primary school in France is to give the instruction a distinct agricultural bias, but not to put the children through an apprenticeship as farmers. The teaching aims at making intelligent farmers, opposed to routine work, and capable of understanding the scientific points of their calling. One of the motives in stimulating the efforts of the teachers in the direction of agriculture is the desire to retain the people on the land. Great attention is given to practical experimental work in the schools. On all occasions effort is made to explain appropriate theoretical principles by practical demonstrations.

The same motives appeal to us New South Wales teachers, and the same aims are before us. French educationists and French teachers are giving us a very valuable lesson in regard to our duty towards our pupils.

Primary School Work.

The lessons given in the Upper Primary Schools of France are classified under the head of practical agriculture, and embrace two kinds of exercises—outdoor and indoor.

The outdoor exercises consist of operations in the garden and field, chiefly experiments and demonstrations—ploughing, scarifying, vineyard work, gardening, vegetable and arboriculture, fruit-trees, poultry and bee-farming, excursions to markets and fairs, farm accounts. All operations are followed by written reports which are carefully corrected by the head-master. The indoor exercises of the pupils are carried out in connection with manual work, and attention is given to the construction of useful farming articles. As an indispensable complement to their theoretical teaching in the subject, the pupils are instructed practically in a knowledge of the various field manures, in the mounting and dismounting of agricultural machines, and in the treatment of cattle. This is essentially a practical programme, and a reference to the time-table appearing on page 139 of the Interim Report shows that, in the agricultural section of the upper primary schools of France, three hours a week for two years are devoted to agriculture and horticulture, and six hours a week from a total of thirty are spent in either manual or practical agricultural work.

Specialisation in these schools is allowed when the pupil is about the age of 14 years. Horticulture, theoretical and practical, is included in the curriculum of the girls' upper primary schools in France, and the subject is taught by the regular teachers of the staff, who qualify for the work by means of courses of practical gardening given in the normal schools.

HOLLAND.

In no part of Europe is the subject of agriculture treated more systematically than in Holland. By means of Nature-study, associated with the object-lesson teaching, in which the endeavour is to awaken the mind and intelligence of the pupil, the teachers of the primary schools of Holland introduce points of interest connected with the growth of plants and flowers.

State Training in Agriculture.

In some of the State Training Colleges for teachers, agriculture and horticulture form part of the regular course of instruction, and special diplomas are offered by the State for proficiency in both branches. Students prepare for these diplomas by following the courses of the National Agricultural College or by private study.

Besides these institutions, students have opportunities for learning agriculture and horticulture through free classes established at various centres and conducted by State Professors of Agriculture and Horticulture, Directors of Agronomic Stations, or Members of the Staff at the winter schools. It is said that this branch of instruction of late years is increasing in public estimation.

The instruction in Nature-Study at the Haarlem Training School, and the time-table of the Practising School attached, are given below. (The extract is from Mr. Medd's Report, Supplement to Vol. 8—Special Reports.)

First year:—Observation and description of certain plants, easily recognised. The different forms of leaves, stems, roots, and the structure of flowers. The morphology of plants. Each student has his own collection of mounted specimens.

Second year:—Continued study of plant-life. Inflorescence, position of leaves and fruit. The principles of classification. Characteristics of the principal families. Nutrition of plants: formation of starchy matter from carbonic acid and water: conversion of starchy matter into glucose: formation of reserve nutritive material: absorption of water: evaporation of water at the surface of the leaves.

Third year:—Arrangement of plants. Object and character of classification. Fertilisation, reproduction, respiration, nutrition, and something of the anatomy of plants.

Fourth year:—General recapitulation: morphology, physiology, and classification.

In

In Zoology the following is the course :—

First year :—Mammals. The observation, description and comparison of certain mammals. Comparative study of the skeleton, external form, nourishment, and habits.

Second year :—The rest of the vertebrates. The study is always comparative. Respiration, the circulation of the blood, digestion, animal heat.

Third year :—Insects : after comparing them, their general characteristics and those of the different orders are studied.

Fourth year :—Molluscs and the lower orders. General recapitulation of zoology.

Horticulture is taught theoretically and practically. The theoretical instruction, which is given mainly in the winter, is illustrated by experiments and the analysis of soils. For the practical work there are two pieces of ground, one about 10 mètres by 20, and the other 15 mètres by 30, divided into rectangular plots. These are cultivated entirely by the students ; the teacher is the Professor, who gives the lessons in class. A year or so ago a practical gardener was engaged, but failed as a teacher. The scheme of instruction in the garden is as follows :—

First year :—Study of certain growing plants, such as cress, radishes, beans, peas, celery, potatoes, flax, and tobacco. Digest of the theory of agriculture.

Second year :—Study of cereals, maize, hemp, buckwheat, caraway, sunflowers, chicory, spinach, onions, purslane. Fermentation and putrefaction : composition of the soil : manuring.

Third year :—Flowers ; crocus, snowdrop, violets, etc. Chemical manures. Cultivation of tobacco. Nutritious preserves.

Fourth year :—General recapitulation.

The gardening is extremely popular, and there is no doubt that, viewed educationally, the system pursued leaves little to be desired. It may be inadequate from a purely agricultural standpoint, but it cannot be too often repeated that the primary school does not require an agricultural expert. Those students, moreover, who obtain the advanced Diploma in Agriculture, are amply qualified to act as pioneers of agricultural science in the rural districts. There has never been any suggestion that the training of rural should be differentiated from that of urban teachers, and, as we have seen, "Nature-study" is considered to be an essential part of the curriculum in every primary school. As a rule, the students first go to a village school, and then move into the towns, where the salaries are higher.

To every training college a primary "practice" school (*Leerschool*), all the expenses of which are defrayed by the Government, is annexed. The one at Haarlem—a mixed school—has an unusually large garden, cultivated by the children. Its time-table indicates the very comprehensive and *educational* character of the curriculum at the State primary schools.

First Year.		*Second Year.*	
9—9·30	Reading.	9—9·30	Object-lessons.
9·30—9·45	Writing.	9·30—10	Reading.
9·45—10	Gymnastics.	10—10·15	Writing.
10—10·30	Arithmetic.	10·15—10·30	Gymnastics.
10·20—11	Object-lessons.	10·30—11	Arithmetic, Measuring, or Weighing.
11—11·15	Games.	11—11·15	Singing.
11·15—11·30	Singing.	11·15—11·30	Games.
11·30—12	Clay Modelling, or Plaiting.	11·30—12	Paper-folding, or Clay Modelling.
2—2·30	Drawing, or Block building.	2—2·30	Drawing.
2·30—3	Measuring, or Object-lessons.	2·30—3	Arithmetic, Measuring, or Weighing.
3—3·15	Games.	3—3·15	Recitation.
3·15—3·30	Recitation.	3·15—3·30	Games.
3·30—4	Reading.	3·30—4	Reading.

The time-table is the same for every day in the week. Wednesday and Saturday are half-holidays. On Wednesdays girls have sewing from 2 to 3 p.m. ; in the opinion of some of the Inspectors this is hardly sufficient.

Third and Fourth Years.

Monday and Thursday.		Tuesday and Friday.		Wednesday and Saturday.	
9—9·30	Object-lessons on Plants, Animals, &c.	9—9·30	Object-lessons on Plants, Animals, &c.	9—9·30	Object-lessons on Plants, Animals, &c.
9·30—10	The Dutch Language.	9·30—10	The Dutch Language.	9·30—10	The Dutch Language.
10—10·15	Singing.	10—10·30	Gymnastics (boys). Arithmetic (girls).	10—10·15	Singing.
10·15—10·30	Games.			10·15—10·30	Games.
10·30—11	Arithmetic, Weighing, and Measuring.	10·30—11	Gymnastics (girls). Arithmetic (boys).	10·30—11	Arithmetic, Measuring, or Weighing.
11—12	Cartoon work.	11—11·30	Clay Modelling.	11—12	Reading.
2—2·30	Nature-study.	11·30—12	Singing.		
2·30—3	Writing.	2—2·30	Geography.		On Wednesdays the girls have their sewing-lesson from 3 to 4 p.m.
3—3·30	History.	2·30—3	Writing.		
3·30—4	Reading.	3—3·30	Drawing.		
		3·30—4	Reading.		

Fifth and Sixth Years.

Monday and Thursday.		Tuesday and Friday.		Wednesday.	
9—10	Reading.	9—10	Reading.	9—10	Reading.
10—11	Arithmetic, Measuring, or Weighing.	10—10·45	Arithmetic, Measuring, or Weighing.	10—10·30	Gymnastics (boys). Writing (girls).
11—11·30	Gymnastics (boys). Writing (girls).	10·45—11	Games.	10·30—11	Gymnastics (girls). Writing (boys).
11·30—12	Gymnastics (girls). Writing (boys).	11—12	History.	11—12	Arithmetic, Measuring, or Weighing.
2—2·45	The Dutch Language.	2—2·45	Composition.		**Saturday.**
2·45—3·30	Object-lessons on Plants' Animals, &c.	2·45—3·30	Geography.	9—10	Reading.
3·30—5	Clay Modelling or Wood-work.	3·30—4·15	Freehand Drawing.	10—11	Cardboard work.
		4·15—5	Nature-Study.	11—12	Arithmetic, Measuring, or Weighing.

Whilst the boys have wood-work, the girls have needlework.

Higher Agricultural Schools.

But the true significance of the agricultural teaching in Holland is experienced in its well-organised higher agricultural schools. J. C. Medd, Esq., M.A., of England, visited the Netherlands, just prior to the Commissioners' visit, and on behalf of the Board of Education, London, studied certain aspects of education there. His report forms a supplement to Vol. 8 of Special Reports on Educational Subjects, compiled by M. E. Sadler, Esq., late Director of Special Inquiries and Reports, England. The section of the report treating on Agricultural Education is of value to us at this juncture, and it is therefore given in full.

AGRICULTURAL EDUCATION.—(*Landbouw Onderwijs*).

Matters relating to agriculture properly fall within the sphere of reports issued by the Board of Agriculture. Still it may, perhaps, be permissible to refer shortly to a few of the main features of the Dutch System, especially in what concerns instruction for lads. In no country is the provision for agricultural education more elaborate, or its organisation more complete than in the Netherlands to-day. This is largely due to the inspiration and ceaseless energy of Dr. Sickesz, late Director-General of Agriculture, who, it is hoped, will eventually become President of a distinct department of agriculture. At present, all agricultural affairs are administered by one of the divisions of the Ministry of the Interior. To assist the Ministry, a central Council of Agriculture, composed of representatives elected by the various Agricultural Societies, meets periodically at the Hague. Practically, nothing is done without the advice of this Council. Each of the Eleven Provinces has a State Professor of Agriculture, whose duties are to inspect and direct the five State experiment stations (*proefvelden*), give lectures, provide instruction for primary school teachers, who wish to obtain an agricultural certificate, and inspect winter agricultural classes in receipt of a State subsidy. In the six provinces with permanent State Winter Agricultural Schools, the Professor is Director of the school. Four of the provinces have State Professors of Horticulture as well, whose duties are *mutatis mutandis* the same. Five State Agronomic Stations have been established for the purpose of analysing manures and food-stuffs, and testing seeds; the one at Hoorn, which is the centre of the dairying industry, is provided with a bacteriological laboratory. Dr. Sickesz courteously furnished me with the following details of the State expenditure for this year:

	Florins.
Director of Agricultural Education:—	
Salary	3,500
Travelling expenses, etc.	1,100
Agricultural College at Wageningen:—	
Salaries	108,100
Maintenance	83,771
Subsidies granted to voluntary associations for courses and lectures on agriculture, horticulture, forestry, dairying, etc.	91,722
Winter schools	39,200
Teachers of Agriculture and Horticulture appointed by the State:—	
Salaries	38,500
Travelling expenses, etc.	22,075
Training of primary school teachers	8,500
Veterinary College at Utrecht:—	
Salaries	54,500
Maintenance	36,700
Subsidies for courses on farriery	3,600
Total	491,268

This sum of £40,939 compares very favourably with the £8,000 placed at the disposal of the English Board of Agriculture for educational purposes.

At the head of the agricultural education stands the College at Wageningen, an institution conducted throughout in the most workmanlike manner, and justly enjoying a world-wide reputation. The long day which I spent there under the guidance of Mr. Broekema, the Director, was too short for anything beyond a very cursory investigation. It comprises four schools or sections: (1) a Hoogere Burger School, with a course of four years for boys up to the age of seventeen or eighteen years. Those who obtain the final certificate proceed to the Higher Agricultural School. The curriculum includes mathematics, mechanics, physics, chemistry, botany, biology, geology, drawing, book-keeping, and modern languages, thus providing an admirable foundation for advanced agricultural instruction; (2) The Intermediate Agricultural School, with a course of two years for pupils of seventeen and upwards. Attached to this is a preparatory class of one year, which is a continuation of primary school subjects, and leads into either the agricultural or horticultural schools. Admission into these schools, however, is not dependent upon attendance at the preparatory class, which is really for those whose previous education is deficient. Many of the pupils from the Agricultural School go to the Dutch Indies, and for them there is a third year in colonial agriculture; (3) The Horticultural School, with a two years' course for practical gardeners, and an additional course of the same length for those who desire more scientific instruction; (4) The Higher School of Agriculture and Forestry, which is divided into two sections, one for home and the other for colonial agriculture. In each of the first three, instruction is given in English, French, and German. The fees are 40 florins, and the total cost for tuition, board and lodging, amounts to about 600 florins per annum. The present number of pupils is 275, including two or three ladies in the horticultural school. In regard to the agricultural students the director made the usual complaint that there are not as many sons of farmers as there ought to be. The system of short courses has not yet been tried, and the ample provision of agricultural education locally perhaps renders it unnecessary. In horticulture, for which there is an excellent garden of some six acres with a considerable quantity of glass, the students rightly do more practical work than in agriculture. Upon this point, it was instructive to learn from Mr. Broekema that the attempt to combine the teaching of the science and the practice of farming had completely failed at the old college at Groningen, which was consequently closed in 1870. At Wageningen, there are extensive experiment and demonstration plots, but the small farm of 25 acres is mainly used to illustrate the class lessons.

Officers preparing for the "Intendance" service, who go to Enschede for an industrial and commercial course, have a previous course of six months' instruction at Wageningen. They are selected by competitive examination, and the Government defrays all their expenses. The instruction, as laid down by the Ministers of War and of the Colonies in 1891, must include botany, husbandry, zoology, the breeding and care of animals, the composition and properties of milk, the principles of productive agriculture, rural economy, and the chemical examination of human and animal food. This system was inaugurated in 1889. On the occasion of my visit there were three such officers at the college.

Winter Schools of Agriculture and Horticulture.—These permanent schools, which are quite distinct from the very numerous winter classes, are intended for the sons of farmers and market-gardeners. The State bears all the expense, and the commune has merely to provide suitable buildings. They are open from October to March, and the full course lasts two years. Pupils are admitted at the age of 16, after an examination in primary school subjects, and must possess some practical knowledge of farming or gardening. The fees may not exceed 20 florins a session, and are usually 10: in the case of the poor they are remitted. Attached to each of the agricultural schools are professors of chemistry and physics, and, as at the experiment stations in the United States, a veterinary surgeon, whose services are available for the neighbourhood. Groningen, Goes, Sittard, Schagen, Dordrecht, and Leeuwarden have agricultural schools. A glance at the map will show how judiciously they have been distributed to meet very varying agricultural conditions and industries. They certainly afford the most effectual means of bringing the best instruction to the doors of the people, and are on that account preferable to any system of short courses at collegiate centres. Even during the winter, those engaged in the cultivation of the soil have many duties to perform, which render it difficult to be absent from home. The instruction in agriculture is

is theoretical, but there are frequent excursions, and each school has a small demonstration plot and botanical garden. First-rate apparatus, diagrams, and the expensive papier-mâché models are liberally supplied. At the end of the first session there is an examination, and those only who are likely to profit by further instruction are allowed to remain for a second year. Diplomas are granted at the end of the course. The schools usually meet five days a week from 2 to 6 in the afternoon. Subject to their being qualified in other respects, pupils may be of any age above 16. Appended is the scheme of studies at the agricultural school at Groningen :—

Subjects.	No. of hours per week.		Subjects.	No. of hours per week.	
	Class I	Class II.		Class I.	Class II.
Nature of the soil, and tillage	2	2	Farm accounts	—	1
Manuring	2	2	Chemistry	3	2
The raising of crops	2	2	Physics	2	1
Animal physiology	3	2	Botany	2	1
The breeding of animals	—	2	Zoology	2	2
The care of animals	2	1	The Dutch language	2	—
Hygiene	—	2	Arithmetic	2	1
Dairying	1	2			
Rural economy	—	2	Total No. of hours	25	25

Horticultural schools have been established at Naaldwijk, Aalsmeer, Tiel, and Boskoop. Their organisation is similar to that of the agricultural schools. The instruction is rather more practical, and each school has a large experiment plot, provided by some private society. For the experimental work, the State makes a special grant of 1,500 florins per annum. Generally, the pupils have lessons in French, English, and German, commercial correspondence, and commercial geography, subjects of great importance in view of the large export trade in fruit, flowers, and vegetables. The school at Naaldwijk is about six miles from the Hague, in the Westland. This fertile district is the centre of a most flourishing horticultural industry. Within the immediate neighbourhood of the village no less than a thousand market gardeners are engaged in profitable trade. The equipment of the school is complete, and would put to shame many of the more pretentious institutions. Its annual subsidy from the State is 2,000 florins, exclusive of the Director's salary. The garden, in which some of those who attend the winter school were at work, covers an area of 5½ acres, and is the property of a Co-operative Gardeners' Association. This Association, with a membership of 300, and a capital of 30,000 florins, recently purchased the land for 13,000 florins. Two skilled gardeners, who have all vegetables free, and salaries of 700 and 850 florins respectively, and two labourers with salaries of 400 florins a year each, are employed. The Westland is noted for its grapes, and the extent of the operations may be judged from the fact that in the large new vinery alone there are 62 varieties of them. Seven hundred different kinds of peaches, apricots, pears, and apples are cultivated. In the potato plots some interesting experiments were being made with kainit and other chemical manures, but it was too early to form any opinion about them. During the summer, Mr. K. Wiersma, the Director, is at hand to advise the gardeners of the district, and to him is due the present popularity of the school. For two years after its establishment in 1896, it met with considerable opposition, but Mr. Wiersma, who was appointed in 1898, succeeded in overcoming this prejudice. The appearance of the garden is the best evidence of his skill as a teacher, and from the proprietors of two large private gardens, which I also visited, I heard nothing but praise of the school. To dispose of the produce of the neighbourhood, without the trouble and expense of finding a market, sales by auction are held in the village market-hall five times a week in summer and three in winter. Nowhere have I seen a more successful combination of State aid and local enterprise than at Naaldwijk, or greater benefit from voluntary co-operation. The export trade in fruit alone to England increases annually in value, but there is no reason why with a little organisation it should not be supplanted by our own fruit-growing counties. It is not due to better climatic conditions.

The Colony of the Société de Bienfaisance.—No survey of education in the Netherlands would be complete without some mention of the great work of this Society. Many descriptions of it have been written, and here we are concerned solely with its educational methods. These methods have enabled it since its foundation in the famine of 1816, to do more than any society towards solving the problem of dealing with the unemployed. From almost every town a committee sends some of those, who would otherwise be paupers or criminals, For these colonists, who number 2,000, every form of practical instruction is provided, and their future status in the colony depends upon themselves. For the children, there are five public primary schools ; boys on leaving them must attend a continuation class for two years, and girls a sewing or needlework class until their sixteenth year. The lads are then trained for various trades, the railway, post or telegraph services, the Army—(there is a flourishing Lads' Brigade)—or the Navy, as farmers, or gardeners. Intermediate schools of horticulture, forestry, and agriculture have been established, each of which has an annual subsidy of 2,500 florins from the State. The horticultural school, which is attended by lads of 15 for three years, has an extensive and well-kept garden of 12 acres, cultivated entirely by the pupils. Many of their drawings and paintings of flowers are admirably done. The school is not confined to the sons of colonists, and it is pleasant to know that no ill-feeling exists between the children of independent parents and the others. The school of forestry, with a course of two years, has a large nursery, and about 60 acres for clearing. Theoretical instruction is given at the agricultural school during two winters, and practical work is done on one of the Society's farms in the summer. There is also instruction in dairying. The colony is not self-supporting, but depends upon subscriptions and legacies. These amounted to 33,409 florins in 1899. Religion is the basis of the whole institution, but it is entirely free from any spirit of sectarianism. One Catholic and two Protestant churches have been erected. No estimate of the work can be formed without a personal visit For miles and miles one traverses land reclaimed and brought under cultivation as effectually as that of La Sologne in France.

Belgium.

The excellence of the agricultural teaching in Belgium, especially that of the kitchen garden, is fully attested by the splendid quality of the fruits and vegetables one gets in the public dining-rooms of that country. A visit to the schools of agriculture and horticulture is a pleasing and valuable experience.

Vilvorde.

One of the finest of these schools is that of Vilvorde, near Brussels, the capital. The students, eighty in number, enter as young as 16 years of age, and the instruction is both theoretical and practical. The course extends over three years, and the aim of the institution is to make practical farmers, gardeners, and nurserymen. In connection with the lecture work, there are class-rooms for modelling, drawing, physics, chemistry, and a museum well furnished with models of fruit, diagrams of plants showing various processes in propagation, etc. On the practical side there are several acres of ground laid out in fruits, vine, flowers, vegetables, grasses, shrubs—foreign and native. In the orchard section of these college grounds there are no less than 2,800 species of pear-trees. Several of these trees are trained in various forms—upright in iron frames, across which wires are stretched ; in little bushy shrubs ; in fork-like forms along a low border ; and in every case loaded with very fine fruit. Vines bearing grapes of delicious flavour, and of great size, are nurtured in glass and hot-houses, and are trained in a semicircular direction from side to side of the building. The Director states that he has 200 varieties of grape-vines in his grounds.

Gembloux.

Gembloux.

This is a university agricultural college situated only a very short distance from Brussels. There are 125 pupils in attendance, of the age of 17 years and upwards, and the course extends through four years. This institution aims at making scientific agriculturists, and fitting its students for positions as managers of estates and experts in special branches of agricultural work. Among its chief attractions are :

(1) *Congo Hot-house.*—A building in which are grown no less than 300 different species of plants found in the Congo region. The training has been found beneficial to agricultural students who have been appointed to the Belgian colony in the Congo.
(2) *Cabinet of Congo Products.*—Woods, seeds, sugar-cane, caoutchouc.
(3) Cabinet of wheat and other cereals from all parts ; tobacco.
(4) Botanical laboratory for germination and culture, for bacteriological and microscopical investigation—a great equipment.
(5) Cabinet of textiles—silk, wool, etc.
(6) Machines for fish-breeding.
(7) Fertilisers : Models of fruit and vegetables.
(8) Library of upwards of 2,000 volumes on the science of agriculture : numerous periodicals from different lands.
(9) Entomological specimens.
(10) *Zoology*—Boxes of horse and ox—splendid models of eye and heart.
(11) Mineralogy—a large collection.
(12) Mechanical workshop.
(13) Horse-shoeing.
(14) Cabinet of models of horses and cattle used in various other places in Europe—a splendid collection.
(15) Some very fine paintings of horses and cattle on walls of class-rooms.
(16) A group of plans to illustrate lectures in drainage and irrigation.
(17) Models of ploughs and other farming implements ; specimens of all kinds of tools used in working the soil.
(18) Class-rooms and all buildings lit with electricity.
(19) Residential college, in part ; culinary department and refectory not up to the standard of other features.
(20) Botanical models—flowers, etc.
(21) Chemical laboratory—very large, fine equipment ; everything methodically arranged ; separate rooms for first and second years.
(22) Collection of minerals found in Belgium.
(23) Splendid grounds—fine shade trees.
(24) Store-room for all sorts of working machinery—carts, ploughs, etc.
(25) Building for cheese-making and treatment of milk.
(26) Stables for horses and cows—large and airy.
(27) Piggery—styes enclosed with brick, floor cemented.

The grounds for practical demonstration lie near the homestead, and comprise a large area of the richest soil fully cultivated. A sugar-refinery and a brewery in the neighbourhood, owned by private persons, are placed at the disposal of the students specialising in that direction.

A Farm School for Girls.

The Ecole Ménagère Agricole et école supérièure d'agriculture pour jeunes filles à Héverlé, with 1,000 pupils in attendance, and under the management of one of the religious orders of the Roman Catholic Church, has already been referred to. The agricultural department of the school is subsidised by Government, and every encouragement is given by the State to inculcate a liking among the girls for farm life and its duties. With that end in view, the instruction is made to bear upon such subjects as fruit and vegetable gardening, particularly the latter, the manufacture of butter and cheese, the management and care of small animals about the farm, poultry, etc.

SWITZERLAND.

Introduction.—In the matter of providing technical instruction for its people, the little country of Switzerland is quite up to the standard of anything seen in France, Holland, or Belgium.

One of the finest institutions inspected in that country is the Institut Agricole, for the Canton de Vaud, Lausanne, which is a training college for youths intending to make their living on the soil.

Agricultural College, Lousanne.

In this College the attendance of students is highest in the winter months. The students are mostly sons of men on the soil, and their services are required on the farms during the busy days of summer. In winter, when work is comparatively slack, and they can be spared, the students enter the Institut, largely for a course in theory of agriculture, but with some little practice. The youths taking the course are destined to follow their fathers as tillers of the soil.

Training of School Teachers.

Students intended for elementary and primary school teaching do not attend the Institut. They receive a short course on the subject—theoretical and practical—in the splendidly-equipped Ecole Normale in the same city.

There is no specialised course of agricultural instruction in the primary or rural schools of Switzerland, but the subject is taken in the daily course, and literature, treating of matter well within the intelligence of the pupils, is circulated among the teachers through the Institut.

The

Among objects of special interest in this College are its—

(1) *Museum.*—A splendid collection.
(2) *Bee-farming Cabinet.*—This industry evidently receives much attention. Here may be seen all types of hives.
(3) *Library.*—Large, well-furnished, containing many French and German works. The courteous director, Professor Bieler, produced one of the latest West Australian pamphlets on Agriculture.

The Commissioner, in his travels through Great Britain and Europe, on several occasions found literature in the shape of pamphlets and printed reports dealing with the development of several of the Australian States, but in no single instance did he see a word about New South Wales. Information on New Zealand may be had in many of the public institutions abroad, and at the Crystal Palace, London, the State of Victoria has, or had in 1902, a very fine exhibition of some of its more important products amply illustrated by means of pamphlets got up in attractive form.

(4) *Chemistry Laboratory.*—The aim of this branch is not to make scientists, but to give students a sufficient knowledge of the soil and kindred subjects, so that they may be able to farm intelligently.
(5) *Cabinet of Models.*—Fruits; specimens of industries, each arrayed in its own distinct compartment showing the various processes in the manufacture from the raw article to the last stage of the finished goods; stuffed birds, local and foreign; skeletons of animals, whole and in part, heads, etc.; cases of cereals in the grain and straw; seeds.

In many of the schools of Switzerland and other parts of Europe the object-lesson teaching card, showing various industrial processes, is common. The firm of McDougall & Company, Edinburgh and London, has recently introduced similar cards into the schools of Great Britain. The firm of Kealy and Philip, of this city, has some of these cards on view.

(6) *Horse-shoeing*—Practical work; anatomy of hoof thoroughly explained by means of natural specimens and models.
(7) *Viticulture*—Various instruments and preparations explained; all diagrams used are of excellent construction and finish; laboratory is furnished with all necessary apparatus for wine-making; museum is well appointed, contains all sorts of tools needed for farm work, local and foreign manufacture; models of fruit-bearing trees, healthy and diseased; destructive and useful birds and insects.
(8) *Anatomical Museum.*—Anatomy of animals explained by means of models and skeletons of domestic animals.
(9) *Geological Cabinet.*—Containing important local rocks.
(10) *Agricultural Implements.*—Some beautiful models of latest ideas in farming machinery. In actual practice one still can see as he goes through the country the common plough, the hoe, the scythe, etc.
(11) *Entomological Exhibit.*—Great attention is given to all insect pests.
(12) *Fungi.*—The different kinds are well shown, and students are taught to discriminate carefully between the edible and the dangerous types.
(13) *Timber Exposition.*—A magnificent display of forest growths—local and foreign.

Throughout the class-rooms and corridors may be seen maps and diagrams giving information, such as habitat of certain cereals, infected areas, statistics of produce, etc. The Director states that the Institute aims at providing in its class-rooms, laboratories, and museums, only what is actually necessary for the practical management of a farm.

(14) *Workshop.*—Agricultural carpentry only is taught.
(15) *Scientific Station.*—On a little platform in the grounds is situated the meteorological station which is fitted up with the usual instruments for indicating weather conditions.

The Grounds.

These, though situated in the heart of the city, are sufficiently large for experimental purposes, and contain various kinds of fruits, vines, and vegetables.

The college is non-residental, and as before stated, is attended chiefly by sons of farmers, vignerons, and others engaged on the soil who intend to follow the occupation of their forefathers.

CHAPTER XLVIII.

PUBLIC SCHOOL, EGLINTON, NEAR BATHURST.

CHAPTER XLVIII.

Agriculture in the Primary Schools of New South Wales.

METHODS ADOPTED AT PUBLIC SCHOOL, EGLINTON, UNDER JOHN HALSTEAD, TEACHER.

[J. W. TURNER.]

Introduction.—A visit to the Bathurst District gave an opportunity to the Commissioner to make the acquaintance of a Public School teacher, Mr. John Halsted, of Eglinton, and to witness his methods of imparting a knowledge of agricultural subjects to his pupils. Many favourable comments on his work, official and otherwise, had appeared in the metropolitan and country Press, and the Commissioner thought it advisable to make the visit of inspection in order that he might be in a position to make his own comparisons and conclusions on the spot. As a subject of school instruction, the Commissioner has no hesitation in saying that the agricultural teaching imparted by Mr. Halsted compares most favourably with that done under similar conditions in the schools of Europe and America.

Mr. Halsted brings to his aid in carrying out this work a knowledge of mixed farming and farm management, acquired as a part of his early home training in England, and afterwards supplemented by visiting Belgium, where dairy farming was chiefly studied; Holland, where land tenure, holdings, and horticulture engaged his attention; Spain, where he spent three years obtaining an insight into fruit culture, curing, packing, irrigation, especially with regard to raising vegetables. In 1879 he joined the Public Service of the State as teacher of a small school at Marlee, on the Manning River.

A report from each of the teachers of the Schools at Numba, West Leichhardt, and Granville on agricultural teaching is appended.

The object of this chapter, and its place in this report, are intended to show what our Public School teachers in country schools are capable of accomplishing in the way of giving a trend to the teaching of elementary agriculture, and to draw attention to the fact that in any development of so important a subject, we have in our own State men thoroughly qualified to carry the work to a successful issue. Mr. Halsted's plan of instruction is unfolded in the following pages:—

Service with the State.

The Public School at Marlee was situated in the centre of a large brush 10 miles from a town, and 2 miles from any dwelling. It was rightly named, for the soil was of a most marly nature. The grounds of the school were covered with dead trees and stumps; the more productive portions had a strong growth of bracken fern. By the aid of fire and hard work, the dead trees and stumps were soon removed. Hard delving and digging soon transformed about a quarter of an acre into suitable land for cultivation. It was found that the various marsupials appreciated the efforts made, for as fast as the vegetables grew, so soon were they demolished. No palings for fencing could be procured, so trees had to be split, and material for fencing the garden was soon available, each pupil being requisitioned to assist even in a small degree. The carting of the fencing material for about a quarter of a mile was a problem for teacher and pupils alike. Assistance was sought, but not being procurable, the initiative of everyone was demanded. After debate it was decided to make a trolly. Two wheels were cut from the end of a log, and bound with hoop-iron to prevent splitting. Four-inch holes were cut in the centre, and a hard wooden axle attached. On the top of the axle a bed was placed of cross pieces of wood. Many hours were spent in the bush finding a piece of wood suitable for a pole. This naturally had to be bent, to allow of a good purchase being taken when drawn. To the end of the pole was attached a rope of ten feet, so that six boys could assist in the haulage. Much interest was taken in the building of the trolly, as only a short period of time was available each day. The fencing material was soon hauled on to the ground. Forked poles were erected, and rails laid on top so that the palings would have support on the top. A trench was dug to insert the ends of the palings, and the tops were bound to the rails with stringybark. The whole work was transacted during play hours, and was made more a matter of enjoyment than work.

Appointment, Marlee Public School.
Clearing school grounds.
Forming a garden and fencing same.
Making a trolly.
Hauling of fencing.

On being removed to Croome Public School, in the Kiama District, fortune favoured the work in that the soil was volcanic and most productive. The position was not the most pleasing for a garden, as it was situated on the top of a high hill, and exposed to the full force of the westerly winds. The garden was surrounded with palings, but on account of the winds, two break-winds of ti-tree scrub were erected. Many different kinds of vegetables were grown, which were exhibited at the Albion Park and Kiama Shows, and succeeded in procuring numerous prizes. As many as thirty varieties of potatoes were once exhibited, and proved an interesting lesson to the farmers around. The following are a few of the garden prizes obtained, and certified to:—

Removal to Croome.
Forming a garden.
Exhibiting at Shows.

This is to certify that at the 1887 Exhibition of the Kiama Agricultural Association the following prizes were awarded:—

Prizes obtained in Kiama District.

1st. Best collection of vegetables.	1st. Best long red radishes.
1st. Best vegetable marrow.	1st. Best white turnips.
1st. Best three lettuces.	2nd. Best half dozen carrots.
1st. Best celery.	2nd. Best half hundredweight potatoes.

In 1888.

1st. Collection of vegetables.	1st. Best collection of herbs.
1st. Best half dozen turnips.	1st. Best collection of lettuce.
1st and 2nd for Kohl Rabi.	1st. Best collection of vegetable seeds.
1st. Best carrots.	1st. Best collection of roots suitable for winter fodder.
1st. Best broad beans in pod.	
1st. Best vegetable marrows.	

(Signed) James Somerville,
Secretary, Kiama Agricultural Association.

PUBLIC SCHOOL, EGLINTON.
(Side View.)

Missing Page

EGLINTON.

Desiring removal to a colder climate, an exchange was effected with the teacher at Eglinton, where gardening pursuits have been carried out on a more extensive scale, and the plot system for the children brought into vogue. Removal to Eglinton.

Apiculture had not been followed as a business, nor yet for home consumption, in the district, and as, without doubt, it would prove a most interesting and beneficial occupation both to adults and pupils, several colonies of bees were procured, and soon an apiary of ninety colonies was established. In apiculture, the hives and appliances are always the chief expense. After consideration, it was found that they could be more economically made than procured, so several 100 feet of "American shelving" was bought and cut up into lengths. The boys were instructed in the making of hives, bar-frames, and any necessary appliances. Both girls and boys received instruction in the hiving of swarms of bees, transposing, extracting, and general management. As an apiarist.

As the hives, frames, appliances, and honey began to increase, a house was necessary for the proper storage of so much material. The point to be fostered and kept in view, where children are concerned, and in fact in all Australia, is resourcefulness (making use of what is to hand). The only means available for a house or store-room was one made from wattle-and-dab. The posts for the corners were obtained from the teacher's wood-heap; holes were sunk, posts erected, the dab (mud and straw) mixed, and soon the walls appeared. For a roof, corrugated iron was used. The house was divided into two compartments, one for a workshop and the other for a store and extracting room. The former was fitted with a carpenter's bench, and the necessary tools were procured. Erection of honey room, etc.

The desire to be allowed to work at the bench by the pupils during the dinner hour, and after school, was keen. Much enjoyment, combined with instruction and work, resulted, as has often been borne testimony to since the lads left school. Half a ton of honey was taken the second year, and many people, finding out the advantage of having honey for winter use, were induced to take the business of apiculture in hand. Possessing bees and managing bees was soon found to be entirely different, consequently the "master" was constantly in demand to rectify some dilemma. Making bee appliances.

Many exhibits were shown at the local show, and much controversy took place. Honey from different flowers was taken as it was brought in by the bees, and each bottled separately; they ranged from light amber to black. (The earlier in the season the lighter the honey; the later in the season the darker). It was affirmed ("by those who knew") that these honeys were doctored; but when the flowers were smelt in conjunction with the honey the evidence was conclusive, and critics were silenced. Exhibiting honey.

Everything that honey could be utilised for was made, such as vinegar, mead, confectionery, preserves, etc.; and these, together with the full appliances, secured the Government prize of £5 in 1896. Successive droughts so prevailed that apiculture had to be relinquished. The flow of honey was dependent on Leguminous and Carduus plants, and, in consequence of their being no trees to supplement the loss, the bees dwindled and died. Government prize for honey.

Copy of Certificate.

Bathurst Agricultural, Horticultural, and Pastoral Society.

This is to certify that Mr. John Halsted, of Eglinton, secured the following prizes:— Prizes in 1891 and 1892.

1st prize for honey in comb, 1891.	1st prize for honey in comb, 1892.
2nd prize for honey in bottles, 1891.	1st prize for vinegar, 1892.
Special prize for extracted honey, 1892.	Government prize for bee appliances, 1892.
1st prize for honey in bottles, 1892.	Government prize for parasites in fruit, 1892.

(Signed) W. G. THOMPSON,
Hon. Secretary.

(And stamped.)

As the number of pupils increased, a more extensive garden area was enclosed, and was found to command more attention from the pupils as a whole. In gardens there is always something that can be done, and as prizes had been generously offered by residents for neatness and variety of growth, rivalry was naturally very keen. The results were gratifying, although not remunerative to the teacher, who had to find both tools and seeds. The Department of Education, taking the matter of playground cultivation in hand, offered bonuses for teaching object-lessons and lessons in agriculture, horticulture, and elementary sciences. The Report of 1891, page 25, states:— Evolution of garden at Eglinton.

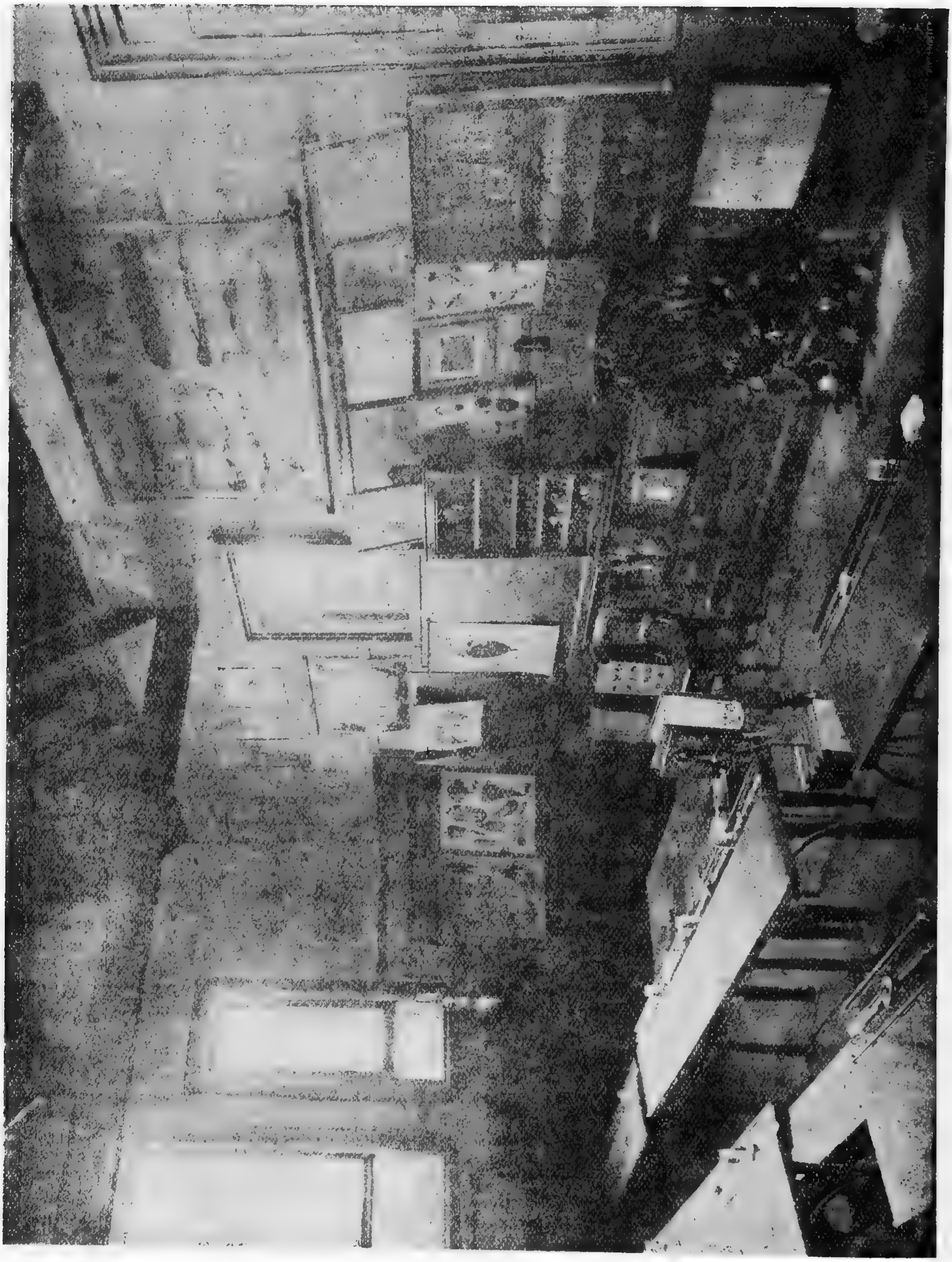
> "Under the direction and supervision of their teachers, the pupils, in a large number of schools, receive practical instruction in cultivating flowers and vegetables in the school grounds. The special instructor reports favourably on the progress made. One hundred and thirty-seven schools were visited by the officer, and eighty-eight teachers succeeded in qualifying for the bonuses of from £1 to £5. Arranged in order of merit, as regards the results achieved, Eglinton school ranks **first.**" Report of Education on playgrounds.

From 1891 to the present time the plot system has been used, and theoretical and practica lessons systematically given in conjunction. In no way could the new syllabus have been forecast, but, fortunately, the Eglinton work has dovetailed with the syllabus and meets the requirements in teaching nature studies.

Many difficulties have had to be overcome, such as the exposed position, the poor, stiff, unkind soil, and the droughts. To meet the first, all cultivation had to be conducted under a tall fence, where the heat was excessive. The soil had to be manured with sand and lime, dug deeply and often, and some had to be burnt. This, naturally, was disheartening to children, but their persistence soon rendered the stiff clay loam into a soil sufficiently friable to attempt cultivation. Difficulties in forming gardens.

The only means to meet the drought was to dig a waterhole and conserve all the surface water. A hole was accordingly laid out, 10 feet x 8 feet x 2 feet, which took a fortnight to accomplish. To this, surface drains were cut, and as the catchment area is fairly large, a good thunderstorm has only to take place to give a supply of water sufficient for a month or six weeks. Such water for vegetables is preferable for gardening purposes to either well or tank water, as it is exposed to the air. Means to water gardens.

The laying-out of the ground, so that the playground was not infringed upon, had to be considered. The accompanying plan of the school area depicts the plan adopted. According to the number of children capable of looking after a plot so is the ground allotted in pieces, 9 yards x $5\frac{1}{2}$ yards. The surplus land is used for growing experimental crops, so that the children can follow the growth of many commercial plants, such as wheat, oats, barley, clover, linseed, chicory, mangold, etc., and note their suitability or otherwise. Laying-out garden into plots.



The growths in many instances are abortive, in others normal, and in many excellent; this is clearly shown by different modes of cultivation and manuring, and many would reach better proportions if given suitable conditions of soil and climate. Various manures are experimented with, such as potash, sulphate of ammonia, phosphates, superphosphates, lime, ashes, stable and green manures, blood, refuse from boiling-down works, and commercial manures. As plots with the various manures are side by side, those most suitable to the plants, soil, and climate can be watched and compared. **Cultivation.** **Manuring.**

The children's individual plots are about 220 square feet in size, for which each child is held responsible as to cultivation and neatness. Any vegetables or flowers can be cultivated, provided they are systematically and carefully planted. The seeds have generally been found by the teacher, and the produce grown is taken home by the grower, subject to the teacher's approval, and after consideration has been made for other pupils. The paths in respect to neatness belong to the beds to which they are opposite, and must be kept clean and tidy. The following list of vegetables and forage plants are those grown by the children in their respective beds. The plots number twenty-one:— **Children's plots.**

Roots.—Carrots, parsnips, beet-root, white carrots, kohl rabi, turnips, radishes.
Bulbs.—Silver-skin onions, Spanish onions, garlic, eschalots, leeks, tree onions, potato onions, Chinese eschalots.
Legumes.—Kidney beans, scarlet runners, broad beans, Canadian Wonder, Lima beans, Madagascar beans, zebra beans, peas, tares.
Green Vegetables.—Cos lettuce, cabbage, lettuce, Neapolitan lettuce, Drumhead and Succession cabbage, red cabbage, silver beet.
Cereals.—Wheats: Russian, Egyptian, purple straw, nonpareil, white lammas, prolific buck.
Barleys: Cape, skinless.
Oats: Algerian, Tartarian, foxtail, potato.
Grasses: Prairie, canary, linseed.
Canes.—Amber, Planter's Friend.
Millet.—Hungarian millet, white seeded, red seeded, grey seeded, pearl, broom, French, Japanese.
Corn.—Red, rice, variegated white, vegetable, ninety day, Argentine, Red Hogan, Yellow Hogan.
Potatoes.—Early rose, Ashleaf kidney.

The following comprise the plants grown in the experimental plots by the pupils for edification and instruction:—

Cereals.—Twenty-five varieties of wheat, six varieties of oats, six varieties of barley, two varieties of rye.
Roots.—Red and yellow mangold, kohl-rabi, white carrots, silver beet, sugar beet, chicory, red beet, turnip beet.
Clovers.—Trifolium, English, Burnett.
Canes.—Planter's Friend, red sorghum.
Millets.—Broom, French, pearl, Siberian, gray seeded, white seeded, red seeded, Japanese, Hungarian, Mushishiraza.
Pumpkins.—Eighteen varieties.
Squash.—Twenty varieties.
Pie Melon.—Six varieties.
Gourds.—Eighteen varieties.
Sundries.—Tares, linseed, garlic, pea-nuts, sunflowers, tomatoes, five varieties of potatoes, six varieties of corn, leeks, lucerne.
Dahlias.—Thirty-five varieties.

Each variety is labelled, and any particular mode of cultivation notified, that results may be tested; for instance, various classes of potatoes are weighed and planted, some in halves, some with the main top eyes removed, some whole, and some with and some without manure. The results from these will be carefully weighed and recorded. In horticulture, which is confined to a separate plot, and that the most sheltered from the wind, those flowers most suitable to the climate and soil are grown. Situated as the school is, in the middle of a plain and exposed to the full force of the westerly winds, horticulture is a failure except with hardy annuals, roses, dahlias, etc. **Management.** **Flower gardening.**

The various crops having grown so vigorously, application was made to the Education Department for permission to exhibit a trophy at the 1904 Sydney Royal Agricultural Society's Show. This was graciously granted, and the exhibits were forwarded to Sydney, addressed to the Director of Agriculture, who, not able to find room for the same in the main Agricultural building, placed them in the verandah. It was poor encouragement after a year's arduous work, to see the endeavour of a system for teaching Agriculture in schools so lightly treated. It is to be hoped that the Education Department will adopt some plan for showing school exhibits, and thereby encourage teachers in their endeavour to carry out that part of the syllabus which desires to show that "there is a lesson in each flower, and a story in each stream and bower." The trophy was further exhibited at the Bathurst Agricultural, Horticultural, and Pastoral Society's Show in April, 1904. It was erected by the pupils, under the teacher's guidance, each variety being distinctly labelled with a triangular label, printed by pupils with ordinary "outfit" letters. The trophy received much praise from the President, the Honorable George Lee, Vice-Presidents, Committee, and the public generally, as it clearly demonstrated what children could grow under diligent management. Both Societies granted Certificates of Merit. The following extract is from the Annual Report of the Bathurst Agricultural, Horticultural, and Pastoral Association:— **Trophy exhibited at Sydney.** **Trophy exhibited at Bathurst.** **Reception at Show.**

> "A collection of farm and garden produce and preserved fruits, from the Eglinton Public School, was full of interest and excited much favourable comment, and has led to the establishment of an Association for the promotion of the teaching of Agriculture in Public Schools, a movement which is likely to become of very great national importance."

The President (Hon. George Lee), in moving the adoption of the annual report of the A. H. and P. Society on 1st November, 1904, said—

> "In the farm and garden produce the exhibits were of exceptional merit. The principal feature of this section was from the Eglinton Public School. This had a peculiar interest to the exhibition, and was a credit to both the scholars and their master. It was said that the Minister of Education had expressed his intention of including agriculture in the list of subjects to be taught. This would be a great boon, especially to the country schools."

PUBLIC SCHOOL, EGLINTON.

(Pupils receiving a lesson in Planting.)

PUBLIC SCHOOL, EGLINTON.

(Pupils at work.)

Beside the garden produce, the trophy was greatly augmented with school work, preserves, and pickles. This branch belonged chiefly to the girl pupils, they having been instructed in utilising their garden produce for future use. It is pleasing to report that under their able instructress they were the recipients of much praise. Preserves and pickles in the trophy.

It may be asserted with confidence that while the grounds are diligently cared for, the tuition is in no way impaired, nor the interior of the school neglected. As the greater part of the day has to be spent within the school walls, it should be made as attractive as possible, and monotony removed as far as possible. Charts of insects, drupes, birds, vegetables, and flowers adorn the walls, while various sciences are represented by practical collections. Botany is represented by making collections of plants, drying and mounting them; geology in the collecting of minerals and fossils; entomology in the collecting and mounting of insects, which the Agricultural Department is gracious enough to name; zoology in the collecting of reptiles, eggs, and insects, and preserving them in spirit; arboriculture in collecting the various local and other timbers in vertical and cross sections. Interior of school. Sciences represented in school.

There is a small shed within which will be found a vice, bench, and sundry useful tools. Here any breakages of tools are repaired; labels are sawn out, planed, and painted; new handles are inserted, and boxes for raising seedlings are made. Carpenter's shop.

Due care is taken of all gardening implements, each has its place, and, if used, must be returned clean to its position. Care of garden tools.

Any watering that can be done must be conveyed by buckets. Several kerosene tins have been converted into a size suitable for carriage, and wire handles attached. Watering.

No coercion is used to bring into harmony the various branches of work. There is a difficulty rather to restrain the pupils. The various branches appeal more intuitively than the three R's., tact and supervision being the only requirements combined with a word in season. Herbert Spencer in his "Intellectual Education" states:— Method. Herbert Spencer on "Intellectual Education."

> "The relationship between teachers and their pupils is, other things equal, rendered friendly and influential, or antagonistic and powerless, according as the system of culture produces happiness or misery.
>
> "Human beings are at the mercy of their associated ideas He who constantly aids children to their ends, hourly provides them with the satisfaction of conquest, hourly encourages them through their difficulties and sympathises in their successes, will be liked; nay, if his behaviour is consistent throughout, must be loved."

The practical study of Nature must have a beneficial effect on the child and its home life. Their characters would be given an impetus "for high objects, for enduring things"; their thoughts would be purified; their passions subdued; and their intellects quickened to the consciousness "That there lives and works a soul in all things." Herbert Spencer, on "Intellectual Education," places the position most forcibly:— Effect of Nature study on children.

> "Similarly with the correlative requirement, that the method of culture pursued shall be one productive of an intrinsically happy activity—an activity not happy because of intrinsic rewards to be obtained, but because of its own healthfulness. Conformity to this requirement, besides preventing us from thwarting the normal process of evolution, incidentally secures positive benefits of importance. Unless we are to return to an ascetic morality (or rather *im*-morality), the maintenance of youthful happiness must be considered as in itself a worthy aim." Herbert Spencer on "Intellectual Education."

What speaks more definitely of a nation's prosperity than the condition of its home life, not so apparent in towns as in the country? A neat garden and tidy fences depict thrift, and wherever beauty linked with utility is predominant, there some force has been at work, leading on step by step to the realisation "that there is a present God." Hence, enriching the child mind with all that is ennobling must bring forth true *esprit de corps*, and a healthy desire to excel; it will cause a mutual consideration for others; a love for the beautiful and grand, and a recognition that there is a "*grandeur in the beatings of the heart.*" The influence on the public from seeing neat gardens creates a desire to possess similar plots, or to cultivate some plant even in a box. Results speak in after life. Influence on public.

> Even in the stifling bosom of the town
> A garden, in which nothing thrives, has charms
> That soothe the rich possessor.—*William Cowper.*

How much healthier would our towns become, if, instead of festering back-yards, reeking with typhoid bacteria, there were cultivated plants, where plant life could assist in removing noxious gases.

The practical value of the above work must naturally appeal to everyone, as it must create thrift, and produce an elevating effect on the present child mind, germinating now, and bearing fruit in the future. Practical value

> And sweet it is the growth to trace
> Of worth, of intellect, of grace,
> And lead it on from hour to hour,
> To ripen into perfect flower.—*John Bowring.*

Establish educative centres, and they would be productive of arousing in the child mind an activity to acquire, and a desire to utilise the resources at hand, so that after patient diligence and research

> Every thought and every deed
> May hold within itself the seed
> Of future good and future meed.—*Richard Monckton Miles.*

To accomplish beneficial results for the future of so grand a State will necessitate practical and theoretical exponents who, under a systematised programme, can simply and unpretentiously evolve an advantageous system, having for its end the upraising of future generations. Considering that all teachers have not the same gifts, it would perhaps meet the present need if peripatetic teachers were appointed, whose objects and duties might be conducted somewhat after the following:— Future good in peripatetic teachers. Duties of peripatetic teachers.

Objects—

1. To diffuse a more comprehensive idea of the natural forces in agricultural production.
2. To instil progressive and intelligent ideas respecting agriculture, horticulture, viticulture, and apiculture.

PUBLIC SCHOOL, EGLINTON.

(Pupils at work.)

PUBLIC SCHOOL, EGLINTON.

(Pupils at work.)

3. To encourage the formation and cultivation of home and school gardens, demonstrating that the growing of symmetrical vegetables and flowers takes no further energy than the growing of distorted specimens, but adds to their commercial value.
4. To illustrate the growth of insect pests, noxious weeds, and vermin, demonstrating their ravages, and illustrating their enemies and preventives.
5. To make suggestions for the treatment of soils, the improvement of cultivation and crops.
6. To encourage the management of bees for private and commercial purposes, showing the great loss allowed under apiculture.

Duties—

1. To visit outlying localities, giving a series of illustrative lectures on all pastoral, agricultural, horticultural, apicultural, and viticultural subjects.
2. To give evening lectures in the Public Schools, illustrated with views, making the lectures of the most simple character.
3. To make collections of such botanical specimens, animals, insects, and pests as may be of benefit to the Technological Museum.
4. To report localities where insect and other pests are allowed to continue their ravages.
5. To suggest and formulate, where practicable, school gardens and apiculture in conjunction with the teachers.

Lesson Notes.

The following notes form the subject of a series of lessons on Cultivation. Each heading constitutes the theme of a previous lesson, hence the whole may be regarded rather in the light of a rapid and collective review :—

Apparatus.—Test tubes, dry earth, quicklime, seedlings, water, primary rocks, commercial and stable manure.

Headings.—Soil, manuring, digging, sowing, transplanting, thinning, watering, cultivation.

Soil.—Formed from rocks—Decomposition of rocks—Agencies affecting decomposition—Sterile and productive soil—Varieties of soil—Relationship to plant life.

Manuring.—The earth the storehouse of plant food—Relation of organic matter to soil and plants—How plants extract nitrogen from air—Nature properties, and effects of different manures, as green, compost, and commercial—How manure is formed—Benefits of surface and bottom manuring—Effect produced by manuring with or without rain.

Digging.—To lighten the soil—To render it friable—To form a seed bed—To admit light, heat, air, and water—To allow manures and acids to operate—The advantages of deep against shallow ploughing—The advantages of hand to farm cultivation—What tools to use in different soils, etc.—How good digging produces symmetrical vegetables.

Illustrations.—"Parable of Sower, spiritual and practical"—"The Study of Nature"—(*William Wordsworth*).

Sowing.—The difference between deep, top, and shallow sowing—How to cover seeds and what with—Test seeds before sowing with microscope—Soak seeds before sowing in manure water—The difference and width of broadcast and drilling—The precautions necessary for seedlings.

Transplanting.—Remove seedlings by digging. not pulling—Soak seedlings in thick cow manure, water for half an hour before replanting—Water the holes for plants before insertion—Place the tap-root vertically in the hole—Place the plants alternately in the rows.

Thinning.—Ascertain the different widths apart required for different plants—Supplement vacancies—Give room for development—Be careful in dry weather not to disturb any neighbouring seedlings.

Cultivation.—Move the surface to form a mulch, to avoid caking, to admit air and water, and to allow expansion of roots.

Illustration.—"Blessing of Instruction" (*John Bowring*)—"Influence of Natural Objects" (*William Wordsworth*).—"Study of Natural Philosophy." (Herschel.)

Nature Study on Plants.

Nature never did betray
The heart that loved her ; 'tis her privilege
Through all the years of this our life to lead
From joy to joy.—*William Wordsworth.*

Definition.—A plant is a living organised body without sensation, incapable of spontaneous motion, and consists of roots, stem, leaves, flowers, seeds, and fruits.

Varieties.—Plants consist of two varieties—Cryptogamous (invisible marriage) or flowerless, as ferns, mosses, fungi, lichen, algæ, etc. Phanerogamous (visible marriage) or bearing flowers, as rose, lily, peas, etc.

Nutrition.—Self-supporting plants nearly always contain chlorophyll and subsist on air and moisture and the matter dissolved in moisture. Dependent plants subsist almost wholly on matter already organised and have no chlorophyll.

Divisions.—A plant may be divided into seven divisions—seeds, roots, stems, leaves, flowers, fruit, and ovary.

Seeds.—A seed is a ripened ovule, consisting of an embryo, with one or more integuments or coverings. It may consist of one leaf (monocotyledon) or two leaves (dicotyledon), and in a general term may be said to be the reproductive organ of a plant. Great care should be used in the selection of seeds.

Roots.—A root may be called the descending axis of a plant, used for fixing a plant in the ground, and to supply moisture, and is in reality the expansion of the radicle terminus of the embryo. There are four varieties—tap, adventitious, fibrous, and aerial.

Stems.—A stem is the main stock of a plant supporting the branches, limbs, twigs, leaves, flowers, and fruit. It may be covered with chlorophyll or bark. It is slender in many plants and bulky in others.

Leaves.

Leaves.—A leaf consists of cellular tissue (venation), covered with chlorophyll, containing microscopic openings called stomata. It absorbs light, heat, air, and moisture. It may be either simple or compound. It may be deciduous or persistent. Its position may be either opposite, alternate, whorled, or tufted. Its margin may be entire, serrated, toothed, lobed, punnatifid or multifia. It may have a foot stalk (petiole); it may be without a foot stalk (sessile), or sheathed. It may be stipulate or exstipulate, digitate, pinnate, or compound.

Flowers. A flower may be divided into five parts, all of which, in a strictly botanical sense, are "*leaves*"—Calyx or sepal, the outer covering of a bud; carolla or petal, the coloured leaves of a flower; stamens with head (anther); stalk (filament), the male organ for furnishing pollen; pistil or carpel (head stigma), (stalk style) may be simple or compound, and is the seed-bearing organ of plant. The word "flower" belongs rather to plants cultivated for ornamental purposes, whereas the word "blossom" belongs to plants producing fruit after the flowering.

'Tis sweet to muse upon His skill displayed
(Infinite skill) in all that He has made.—*W. Cowper.*

Ovules.—An ovule consists of a soft nucleus with two delicate coatings, and contains divisions known as ovaries, in which are found seeds. An ovary is a part of the pistil, and may develop into a fruit.

Germination.—Germs are those portions of a seed which develop a new life. They have two distinct actions, the act of germination and the act of development. Heat, moisture and air are necessary for germination. Seeds absorb moisture, swell, and soften. Seeds in a resting state contain "zymogen," or mother of ferment. The absorption of moisture develops a weak acid, which converts the zymogen into various ferments. This renders the food material soluble, enters into the circulation of the embryo, and is used to build up the new tissue of the sprouting plant.

Russet and rude fold up the tender germ
Uninjured, with inimitable art;
And, ere one flowery season fades and dies
Designs the blooming wonders of the next.—*W. Cowper.*

Cross fertilisation.—In order to produce a variety of plants, the system of cross-breeding is largely practised. Open the glumes and remove the anthers of the selected parent plant. Take the ripe pollen of another parent, and dust it over the stigmas of the first parent, close the glumes and cover with muslin to protect from birds. The operation is greatly practised, the varieties of flowers, fruits, and grains being the result.

Uses.—The production of plant life is so inseparable from human existence that the requirements of mankind must necessarily be the application of productiveness to requirements. Hence in every department of life the economic application of plants is necessary.

Apparatus.—Free use should be made of diagrams of plants and their parts. Specimens when possible should form illustrations.

EGLINTON METHODS FROM THE STANDPOINT OF THE GENERAL PUBLIC.

The schoolmaster is a factor making for good in the community in which he labours, and his influence is often felt outside the walls of his own little school.

The Eglinton methods and successes have awakened considerable interest in the minds of the citizens of Bathurst. So much were they impressed with Eglinton work, and so greatly did they desire to see Eglinton methods extended throughout the district, that in October of last year a society was formed in Bathurst, with the Mayor, A. E. Ennis, Esq., as President, called "The National Association for Promotion of School Agriculture," having for its objects—

I. To stimulate interest in the cultivation of school plots among the scholars of primary and other schools.
II. To stimulate the interest of the general public in Agricultural Education, and to suggest the offering of trophies and prizes, etc., among schools.
III. To encourage self-help among the children.
IV. To encourage a spirit of school comradeship.
V. To supplement the children's own funds by grants in aid for tools—when found absolutely necessary and practicable.
VI. To, above all, make the tillage of school plots march parallel to the Education Department's new Syllabus—
  (*a*) While preserving the individual freedom of teacher and child;
  (*b*) While studying local or district characteristics of soil or product;
  (*c*) While ensuring that the working of the plots shall be, as far as possible, left entirely to the sympathetic interest and option of the children.

In the inauguration of this association two gentlemen, Mr. W. Astley, journalist, and honorary secretary to the movement, and Mr. John Halsted, teacher of Eglinton, were deeply interested.

Mr. Astley writes as follows on Eglinton methods:—

The character of a district is, as a rule, to be interpreted by its schools, and, thanks to a far-sighted and broad-minded regulation which secures to any member of the general public who is himself watchful of his words and conduct, and mindful of the respect due to teachers and scholars, a cordial welcome in any school controlled by the Department, a visitor to the country districts can, by a brief inspection of a school, gain a clear impression of the characteristics of the surrounding people. The rural school is a truer index

index to the work of our institutions and the fibre of our population than almost any other social feature. The great metropolitan and suburban school, and its compeers of the larger centres, do not represent in the same potential degree a social force or a factor moulding the national character. In a city, churches and their associated enterprises, Schools of Arts, reading rooms, halls of recreation, are all as effective as public Schools, but in a rural centre, from the closer intimacy between teacher and taught, the personality of the schoolmaster, the character of the tuition and that of the discipline preserved, the schools become of greater moment to the State. Holding this opinion, it was only a matter of time for the work done at Eglinton Public School to be brought to my notice, when engaged as a journalist, in inquiries as to the characteristics of the district, sojourning in Bathurst, in the latter part of 1903. As a consequence Eglinton was visited, not once, but a dozen times. The attention of at least two other metropolitan journalists was directed to the method pursued, and the method itself was described and discussed in the local press. Its value received practical proof and illustration in the notable Eglinton exhibit at the important Bathurst Agricultural Show of April, 1904, the educative influence of that exhibit (extending as far as Queensland) was such as to leave no doubt on the mind of the writer that, as a mere matter of public duty, the principle and details underlying the Eglinton method should be widely published, and, where practicable, brought to bear in other districts. The Eglinton method, it was felt, was not of a nature necessarily to be confined to Eglinton. It had only to be made known to enlist the co-operation of many other teachers, and of numerous members of the general public. The Eglinton master himself, while like all true teachers, desirous of an adequate sphere of labour, feeling eqnal to much more than his Eglinton duties, yet was somewhat averse to the glare of publicity being directed upon the special features of his school-work. He recognised that, first and last, he was an officer of the Education Department, and if, in his own glad and interested pursuit of agriculture, he had succeeded in awaking the sympathies and arousing the activities of some of his scholars, he conceived he would be overstepping the bounds of his own function, if he were to assume he had anything to teach his fellows. On the other hand, it was seen that, however keen-spirited and alert the Department might prove itself in this connection, it was already so overburdened with work, and so indifferently equipped by the State with financial aids, that it was hopeless to expect from it any large extension of its responsibilities. Inspectorial sympathy, in the helpful official approval of the District Inspector of Schools, Mr. L. E. Lawford, M.A., and its formal ratification by the Acting Chief Inspector, it was known that the Eglinton master had, but still it was plain other forces would have to be relied upon if there was to be a widespread movement in the direction of agricultural education, which should operate upon public opinion on one side, and upon individual schools on the other. Consequently, it was understood that something in the nature of an associative effort of people interested would be necessary—effort that would be mindful of the limits of departmental action, and would, in no circumstances, infringe upon the departmental authority. As a preliminary to the enlistment of such effort, the following memorandum was prepared for the information of certain Bathurst citizens who, while sensible of the good that would be effected were a general adoption of the Eglinton method possible, had not had the opportunity of analysing what might be termed the "uniqueness" of the plan adopted at the Macquarie Village. It consists of a hasty manuscript of a journalist's hastily written remarks, and Mr. John Halsted, the Eglinton master, had no knowledge of its existence till it had served the purpose for which it had been written. It makes no pretensions to being either a logical or an exhaustive explication of the Eglinton master's work, and is now given simply for what it is worth.

What first led to the Recognition of Mr. Halsted's Work.

I. Mr. Halsted's persistence, in spite of local misrepresentation, and his perseverance in the face of official apathy, in carrying on the plan of plot-cultivation, for several successive years.

II. This success is creating a personal sympathy on the part of the scholar with the simpler agricultural processes, and of relieving such processes of drudgery.

III. The way in which he made the lessons on agricultural theory work with, or "dovetail" into, the actual working of the plots by his scholars.

IV. Thus ensuring that the lessons, both theoretical and practical, would ultimately converge upon the ultimate good of the district, if not upon its immediate practical needs.

V. The fact that from the first time I called, he left me (after the formal courtesies) to examine all the work of the school (book and plot), and to interrogate the children as I pleased, always taking care that there was no interference with the school-routine.

VI. The fact that he was always ready (subject to the same proviso) to give, in my presence, an illustration either practical or theoretical, of agricultural teaching, just as I pleased.

VII. The fact that the children showed a genuine capacity and willingness to explain, as clearly as could be expected from children of average intelligence, the simpler processes of plant-life, and of the art of agriculture.

VIII. The fact—and this impressed me most deeply—that the Eglinton master had not sacrificed the ordinary school routine, in his efforts to give prominence to select subjects, but had maintained his work on the stated programme at the required standard.

IX. The fact that the children receiving this special instruction were as quiet mannered, and, at the same time, as fond of fun and play, as the average school child of their years—if anything slightly better mannered—showed that since their grip on the hard facts of life must have been stronger than that of most children of their age, they were the gainers through the "Eglinton Method."

X. The fact that no extra expense to the State had been caused.

XI. Thus summarising the relation of Eglinton to the Department and the public, I conclude that it would be a good thing for the State if "Eglintons could be multiplied." Suppose a similar method of imparting stimulus and instruction were in force in each of a thousand schools, not, perhaps with the thoroughness of Eglinton, but still with a decided intention of expressing theory in practice, within a quinquennium there would be added to the intelligent working material of the State, without special strain at no particular cost, almost imperceptibly a contingent of a 100,000 units. Classing these units of workers as mentally alert, receptive, and interested in the processes of nature, who can estimate the value to the community of such an increment of mental force. Would not the value be, in any case, incommensurable between the prime money cost to the State of bringing the Eglinton method into general adoption and the intellectual and practical gain to the community?

PUBLIC SCHOOL, EGLINTON.
(Honey Exhibit.)

XII. Complementary to Mr. Halsted's work, and in itself the root of what it only requires, a touch of imagination to behold as leading to the creation of a minor, but still, potential, source of industrial wealth, is Mrs. Halsted's instruction of the girl-scholars in pickling and preserving. The transformation of the raw vegetable grown at Eglinton, and uncooked fruit into table delicacies, has its economic aspect as well as an educational one. It must not be overlooked that here, again (as in the cultivation of the garden-plots), the contributing quality is not coercion or dictation on the part of the instructor, but sympathy and awakened interest on the part of the child.

In the foregoing abstract will be seen the predisposing reasons for the establishment of "The National Association for the promotion of School Agriculture," which after no inconsiderable amount of inquiry on the part of its promoters as to cognate work being done by other schools, has accepted the "Eglinton Method" as furnishing both an ideal and a practicable plan, and one likely to be most easily assimilated by the Department, its teachers, and the general public.

Any advertisement of the "Eglinton Method" would have been at once injudicious and unjust had it operated to the depreciation of any other teacher's efforts, or the method itself had not fallen within the reach, if not of every teacher, of almost every school.

It was known that other teachers had applied themselves to agricultural teaching, and had achieved greater or less success, but it was considered that the Eglinton method had results to its credit which left little to be desired, the conditions of primary education and the means of instruction open to the mass of children being considered.

For the plan followed at any particular school to be taken as in some sense a model one, or to be generally adopted, it has not to depend for its exemplary character on any kind of work or any feature of its management which did not come within

(*a*) the personal equipment of the average teacher;
(*b*) the means of every ordinary school.

It must not call for any singular enthusiasm on the part of the master, for any exceptional intelligence or energy on the part of the scholars. Ordinary energy, ordinary intelligence, ordinary aptitudes, common qualities of interest and industry, must be at the command of the Education Department if it seeks to make compulsory the study of the simpler agricultural processes as a part of its methods of primary education. Lacking the element of compulsion, any organisation which aims at making such study general through the excitement of a spirit of emulation may enlist the "hobby-instinct" in master and scholar, and seek to transform it into an educative force, but can only compensate itself for the absence of a coercive influence by appealing to individual initiative and a reliance on public spirit and fervent patriotism. Granted that to establish and carry on, year by year for fifteen years, a school work like that at Eglinton requires exceptional abilities of one kind or another, yet, in the manifestation of a like interest in agricultural pursuits in other districts, it is not necessary to look for a corresponding degree of ardour, ability, or experience. Exceptional activities of one kind or another are always needed to create an original or a model, or to supply a primary impulse. So it seemed in the case of Eglinton. In Mr. Halsted there was found a singular union of agriculturist and teacher, and the expression in practical works of his efforts was happily such that it appeared capable of being extended to a limit only co-terminus with that of the State.

Thus, without in any way depriving other teachers of any credit due to them for independent effort, or anything in the shape of public-spirited endeavour to "transcend the narrow limits of duty," and without urging any school to attempt something beyond its compass, the idea took bodily shape in the minds of a few Bathurst citizens that, by the co-operation of Department and public, "Eglinton might be multiplied," and that any such effort, whether it attain full fruition or not, could not help but prove beneficial to the State.

It was considered that by enlisting the help of the general public a volume of sympathy with the purposes of such an association would be created. What arose from the body of the public, and received its main support from it, would be independent of party votes and ministerial patronage, and a movement of this kind, having its origin really in a national necessity, could afford, it was felt, to rely upon its intrinsic worth, and upon a sturdy citizenship, rather than a complaisant officialdom, while careful to gather to its aid all the assistance that could be supplied by departments in the execution of their normal functions.

The movement for School Agriculture was seen to be peculiarly one where the public might grant its aid in the shape of voluntary effort, gifts of tools and seeds, and money subscriptions, without in any way interfering with the freedom of action, or infringing upon the special province of the Department. Necessary, though the public officer is, it would not be at all difficult to demonstrate that a high type of citizenship cannot be evolved through the agency of the Public Department, and the assumption by Government of responsibilities and duties that can be best performed by associations, companies, or individuals, has already been observed to have produced in these States, phenomena which augur ill for the national character. By the alliance in the work of Agricultural Education of the Department and the public, it was conjectured the maximum of effective effort would be attained.

It must not be forgotten that the truest education always comes along the line of self-help, and that the force of this axiom makes itself felt soon and vividly in the domain of the farmer. Resourcefulness is of the very capital of the true farmer, and accordingly every practice that tends to strengthen a farmer's dependence upon and confinence in himself makes him more efficient as worker and producer, and a more potential unit in the country's productiveness. The ready inventiveness that puts to good use a piece of apparently waste material, that turns to purpose a scrap of seemingly unrelated information, that works into a definite scheme an isolated fact, is of value in any department of life, and in none of greater utility than in that of agrarian industry. Now, agricultural education which aims at enabling one to make the most of his faculties and his resources, is, it is obvious, best begun in the primary stage, and preferably, in that stage, if it be at all possible, where tasks are not felt as burdens, but are participated in as pleasures. The modern educator does not despise the "play-instinct" of the child or youth, and sees perhaps in the conduct of its bridge-building or canal-constructing game an indication of a characteristic

to

to be cherished. In like manner, he actually will not be inclined to disparage the significance of the effect on the child's character of his familiarity with "the fine art of growing a carrot symmetrically," especially if that familiarity is gained in hours otherwise presumably devoted to "recreation." In the complex moulding forces of the civilisation of to-day, nothing that affects life or character can be underestimated. Consequently, if by taking advantage of the child's delight "to be doing something," of his instinctive desire to produce, of his instinctive sense of proprietorship to make him acquainted with the rudimentary agricultural processes, and with the beautiful play of natural forces, there is a co-ordination of faculty and occupation—it would be wrong to call that work in which there is no sense of effort, labour, or drudgery—the highest end of education is achieved; another self-dependent, resourceful citizen is qualified to become a producer. This, in short, it is contended, must be the result of the Eglinton method.

The Eglinton Method described.

It may be at once frankly conceded that, like all pioneers, the teacher at Eglinton "builded better than he knew." He attained considerable success, but he had to grow gradually toward the fruition of his own plans, and into the full perception of what might open before, or be included in, his teaching. It was scarcely likely that inferences from his work, of a political or economic bearing, would occur to a teacher of a seventh-class school, remote from the centre of political strife and economic discussion, but that his agricultural pursuits were soundly based and were buttressed by scientific conclusion, is shown by the far-reaching applicability of his deductions, and by the fact that thoughtful students of the Eglinton method had no difficulty in linking his experience to fundamental, economic, and political truths. Nor was it to be expected that he would be prepared, debarred as a teacher necessarily is in great measure from press contributions, to demonstrate the relation between his agricultural lessons and experiment as elements of primary production, and the sociological effect of widespread extension of his system. If there was any vitality in the Eglinton method at all, it would impel examination by others—business men, politicians, publicists—and, as a matter of fact, this is what has occurred. Such publicity as the Eglinton method has reached has been attributable to its capacity to impress and convince others.

What, then, precisely described, is the Eglinton method, as expressed during many successive years of teaching?

(1) Taking the Departmental "Programme" as a starting point, and as specifying the standard of theoretical teaching, the next step has been the observation of the district needs and potentialities. The theory and the needs had to be correlated. With something of bookish facts, to be mastered by rote, at every step the lessons received practical test and confirmation from actual demonstration.

(2) The cultivation of the several children's plots brought the little cultivators face to face with the statement of theory on the one hand, and its specific application to district requirements on the other.

(3) The various processes of agriculture—soil preparation, cultivation, sowing, manuring, weeding, etc.—were revealed as the gradual stages of the evolution of plant-life; the effect of water, winds, frosts traced; incidentally, the distinct varieties and economic uses of the plant grown were dealt with, and necessarily information of a botanical, zoological, geological, and meteorological nature was more or less perceptibly gathered from its successive lessons.

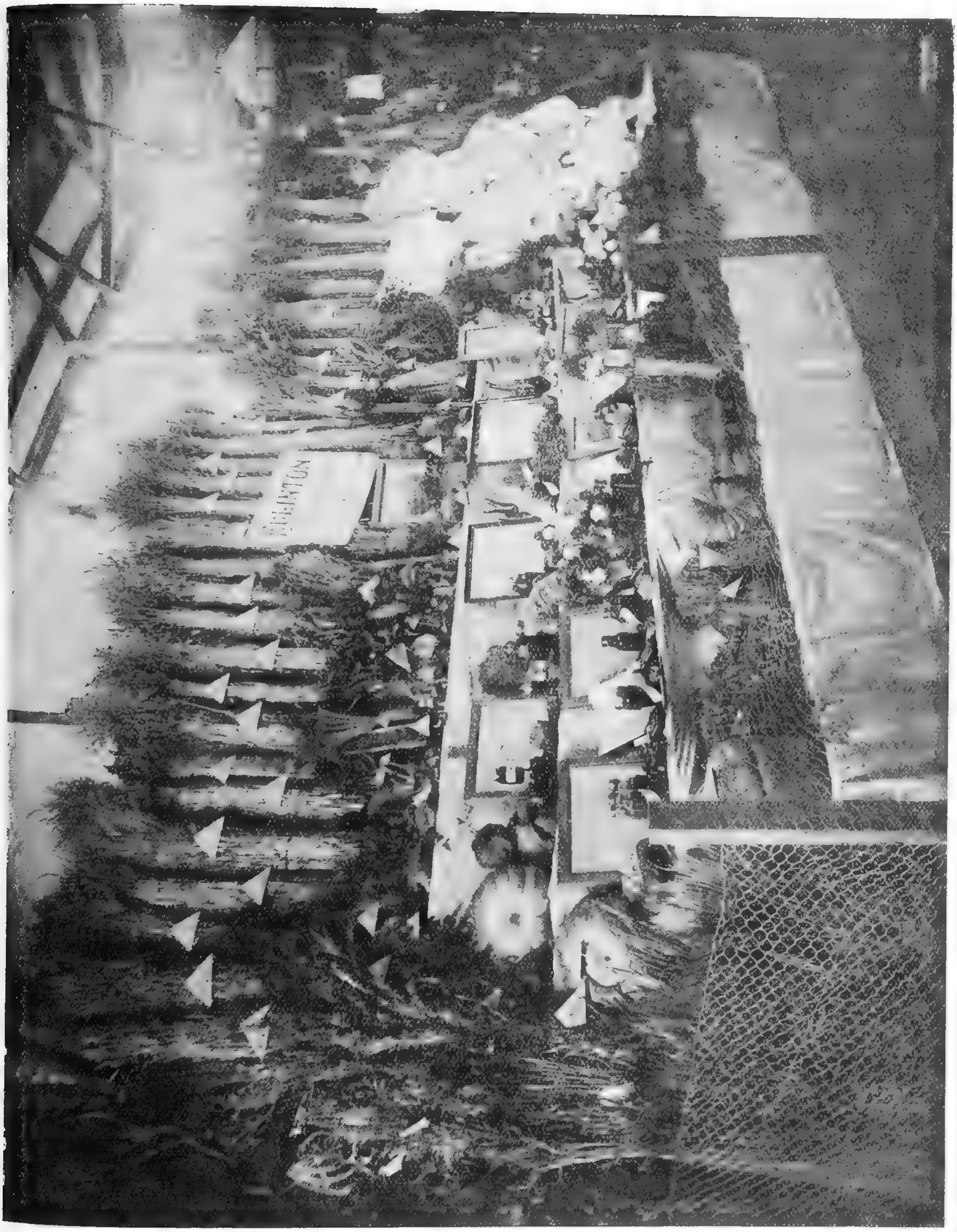
(4) Allied with the children's individual plots were worked some experimental plots illustrating different varieties of cereals and vegetables, and the effect of diverse kinds of manures as affecting various classes of products. The relation of deep and superficial cultivation and intense culture became an object lesson arising directly from the petty area placed at the command of the child cultivator.

(5) Out of the observation of insect life, necessarily grew some elementary investigation of insect pests and their remedies, and into the entomology of the district.

(6) Out of the operations of farm work itself the breaking and scarcity of tools, the relative utility of tools—necessarily rose a demand on inventiveness—a demand educing and creating the faculty. Methods of rough carpentering were applied, and mathematical relations had to be detected and applied; the various descriptions of workable timber—soft wood, hardwood—had to be perceived, the respective capabilities of different implements described.

(7) In the working out of this method the educational principle, at once subtle and sublime, of "Education by discovery" and of "Education by process of self-evolution" naturally became vital. Moreover, the teacher conscientiously working to an ideal, set seeking to achieve something practical, is peculiarly subjected to the temptation of "doing the work himself." Considered as an undertaking having an economic value the making by rough processes of the batten gate on the Eglinton pathway, of available material, by child labour, would, in relation to cost, be quite disproportionate. Considered in relation to the children's instruction, to the development of their faculty, the end is of enormous worth. The digging of the post-holes, the calculation of the material, the measuring of the battens, the adjustment of the hinges, and the weight they would be called upon to support, are all of educational significance, inasmuch as they are reducible into terms of practical importance. Viewed as a job, expressing itself in terms of labour-cost, it would perhaps be an expensive work; viewed as it really was, it became an object lesson of the highest utility.

(8) Showing the scholar the relation between theory and practice, indicating his own worth as a contributor of the elements of labour and intelligence, large drafts were made on his individual powers. He is shown things, he is trained to do things, he is led to follow processes and apply principles. Thus is educed, slowly and imperceptibly no doubt, but still surely, faculty; thus grows the spirit of self-dependence; thus is evolved individuality. And this is achieved not only without the sense of task drudgery and of tedious toil, but the sense of curiosity is awakened, and the personal activities are thrown on the side of production. Is it possible that the benefit of such instruction is easily lost? The whole theory of primary education is disproved, if it be so, and it would be difficult to demonstrate what more is needed to prove that theory than is supplied by the plan thus outlined.



PUBLIC SCHOOL, EGLINTON.
(General Agricultural Exhibit.)

Still remains to be discussed, however, as matters of actual experience and teaching practice, three points:

(9) The ethical and æsthetic relations of the Eglinton lessons.
(10) The worth as an incentive and stimulus to district farmers, of the operations of such methods in their midst.
(11) The Eglinton relation to the new syllabus.

The Ethical and Æsthetic Relations of the Eglinton Lessons.—A well-trained or a "born teacher" will discover correlations for almost every lesson, but the subjects and deductions derivable from a nature-study such as is, of necessity, included in a course of lessons on agricultural topics, multiply to an almost numberless extent, and lend themselves to an inconceivable variety of treatment. Lessons—from the point of view of a naturalist, from that of an exact botanist, that of a worker among industrial processes, that of a mere lover of plants and flowers, that of a poet or a student of economics—all have their places, in the inexhaustible beauty of nature's colour-work, the marvellous fecundity and adaptativeness of her resources, the subtlety of her devices, the delicacy of her machinery, the unerring reign of her order. To such a teacher, themes of that stamp are encyclopædic in their range. The Omnipotence of Deity, His all-encompassing love, reverence, order, beauty, simple perfection of design, scientific precision, delicacy! What qualities that deepen or enrich the child nature are they that cannot be imparted through the medium of such subjects, and on which the teacher's skill cannot exert itself with a well-rewarded exertion? What training of powers, what familiarising through miscroscopic penetrativeness, with the depths and heights of worlds within worlds? The "sweet suggestiveness" of poet and orator of rhythmic phrase and musical cadence are linkable by the teacher's art to the phenomena of plant-life, and when that is done, what exquisite pleasure is not conferred, and what gifts of undying mental splendour have not been bestowed? The often quoted lament of Thomas Carlyle, that he had, as a boy, been kept in ignorance of the wonders of nature, even in her simplest manifestations, has often been referred to with ever-accentuated despair; but if such lessons can now be conveyed to the pupil-mind, with subtle filaments of feeling binding them in one direction to the poet's and the scientific investigator's descriptions, and in a more immediately practical way, in the other, to the farmer's methods, a child becomes educationally equipped in a well-balanced and harmonious fashion. Indifferently provided as a seventh-class schoolmaster is, of obligation, with instruments for observing and preparing specimens, he has, it is apparent to those who have inquired, done enough to justify one in declaring that it is no fancied anticipation of what might be finally attained by some ideal—and impossible—teacher, that the foregoing lines have been penned. The Eglinton master dovetailed his duties as an expositor of the ordinary school-subjects, and average school ethics, to the studies in which he especially enlisted his scholars' interest, and the strength of his achievements rests in the average character of his pupils. The Eglinton method would have little to offer of help to the State if it required to be applied to exceptional children.

The value of district centres of the kind—"not in the bond" certainly, but unquestionably effective agencies for the diffusion of information, and for the amelioration of rural life, centres like Eglinton must exercise a gradual influence. To take but one instance: several scores of bearing fruit-trees were transplanted to a new site, without suffering the least injury, and their owner, an orchardist of several years' standing, published the plan, which he had learnt from the Eglinton master, far and wide. Experimenting with soils, manures, wheats, are all along the line of assistance to the district farmer; the farmer and the teacher are, to that extent, co-adjutors, each is increasing the equipment and experience of the other. It requires no argument to prove that every such school centre becomes a distributing channel of intelligence. For a district to be able to solve its immediate local problems on the spot in precisely the exact conditions of soil and weather must, sooner or later, add to its wealth-producing capacity. This has been found to be the case at Eglinton.

(12) *The Relation of this Method to the New Syllabus.*—Some acquaintance with the method before the introduction of the new Syllabus showed that it had led gradually, through the exigencies of the teaching of a man versed in what might be called the practical details of life, to the formulation of the principles and routine afterwards prescribed by the Department. The method of correlation had been closely followed, and it may be concluded therefore that, should the Syllabus form a natural precursor to the introduction of definite agricultural instruction, peculiar attention will be bestowed by the authorities on the affinity between simple nature study and agricultural education on the Eglinton model. The Syllabus, page 2, says: "Nature knowledge is the term used in the Syllabus to embrace certain parts of Geography, Object-lessons, and Elementary Science. Here again the same fundamental principles should be kept in view, the making use of the child's activity by getting him to do and to make things, the use of means to help him to form vivid mental images, and the encouragement of his interest in his surroundings. The child is in this course to be no passive recipient of information, he will acquire knowledge actively rather than receive it passively. The treatment of this branch of instruction will, therefore, make demands upon the resourcefulness of the teacher in order that he may present it to his pupils in its many-sided aspect." Approximating too, to technical instruction, the Eglinton pupils discovered that they had, in the satisfaction of their needs, learned how to frame implements.

But a narrative of what has been done is not always the best way of securing the adoption of an advantageous plan of action. Can the ideas easily segregate themselves into succinctly-stated principles, and those principles readily arrange themselves into an ordered system?

The Eglinton method lends itself to simple definition.

The Eglinton Method more briefly Defined.

I. Linking, throughout, theory with practice, it seeks to illustrate the mode of practical agriculture by taking as the subject of explication the staple of the district, adding other products as desired by the students, as cultivated in plots by the school children.

II. Allied to agriculture proper, are the ordinary farming operations, also illustrated by actual work, such as the repairing of tools, rough carpentry, preparation of exhibits for shows.

III.

III. The work is made one of sympathetic interest. While the elementary study of the theory of agriculture is compulsory under the Educational Department's programme, the pursuit of the practical lessons is entirely a matter of volition on the part of the child.

IV. Consequently if there is to be any extension of the Eglinton idea it should be left entirely to a matter of volition on the part of the teacher. If instruction in agriculture be demanded from the staff by the Department, there is no doubt teachers will qualify themselves to impart it; but till the instruction is commanded agricultural lessons will be left to the teacher's enthusiasm, and to his conviction that it is a "good in itself" which is to be gained.

V. By action self-imposed, and duties voluntarily undertaken, the whole energy of the boy goes to the cultivation of his plot. His sympathetic interest is enlisted on the side of his own education, and, imperceptibly, he discerns the benefit of what he is doing; he learns the absorbing interest of the art of production. The instinct to produce is rooted in him. The thought penetrates to the boy's mind that the operation of tilling a field is, in his case, a mere question of multiplication. He cultivates an area 9½ yards by 5 yards; he obtains a given product with the expenditure of a given quantity of labour; he will receive a much larger product upon the expenditure of a larger quantity of labour. Further, he has learned something of the pleasure that springs from the production either of superior or increased products as the result of applied knowledge. Thus he has a score of forces converging upon him, all of which are directly and implicitly making an appeal to his individual best. Can a finer "raw-material" for the constitution of an intelligent body of wealth-producers than young people, so trained, be desired?

VI. By the working of boys and girls each in his or her adjacent plot, mutual helpfulness and courtesy are engendered, and, gradually, a keen school spirit; the children in the mass, in the course of time, learning to look upon the school plots and their diverse products as a unit in which the whole school is interested.

VII. The work supplementary to agriculture proper, in pickling, preserving, and bottling for table use products of the farm and garden, legitimately comes within the equipment of the school girl in the domain of domestic economy. Here again, the present factor of individual interest is brought into the problem.

The *Bathurst Free Press* and the *Bathurst National Advocate* have recognised the splendid work done under Eglinton methods, and have opened the columns of their respective papers for information shewing the value of agricultural instruction as a part of the primary school course, and its prospective benefits to those who will take up the duties of farmers. The *Bathurst Free Press* of 13th January, 1904, says:—

What shall be said of the man who from sheer love of the pursuit deliberately and with high intelligence sets his wits to and spends his leisure in producing farmers—training farmers who will farm—farmers who will work intelligently towards definite ends and for given results. In his own time and as a master of his own leisure, he is taking such an interest in district farmers and farming that it is conceivable no more valuable undertaking in connection with agriculture is being carried out in the West than he is conducting simply and unpretentiously.

As is generally the case with wholesouled workers of all sorts, Mr. Halsted is "building better than he knows." Mr. Halsted thinks he is attempting to solve one or two personal and professional problems only. He is curious to learn how certain vegetables—how certain other cereals will grow under certain conditions. So much for the personal problem. Then he is desirous also of arousing the intellectual interests and sympathy of his school children. This is the professional problem. He is on the highway towards solving both of them.

But he is also, unless we are much mistaken, going to solve, or to show how it can be solved, the problem of "How to get our young people on to the land"—to get them there, and keep them there. That is really one of the great fundamental political and social problems facing us as a people. . . . He is establishing a link between the land and the people—the young people, with whom will rest the future fortunes, the progress, and the wealth of the country.

Here is an object lesson supplied by Mr. Halsted at his own cost to his fellow-teachers, to the district farmers, and to the country. It is an object lesson in a study which comes nearest to what, in all likelihood, will be the life study of his present-day scholars. It is an object lesson in the economy of farm production, and so far as Mr. Halsted can make in opportunities in farm management. By Mr. Halsted's method young people are being taught to observe, and note, and trace all the common facts of vegetable and plant growth, and are thus laying the foundation without effort, without strain, for what may be the business of their lives. In a farming district they are being helped to become intelligent farmers. Since what they do they do voluntarily, what they learn becomes part and parcel of themselves, of their vital powers and their daily life. They learn to understand and to appreciate the common things about them—to see a beauty in the stages of plant-growth, and something far removed from drudgery in the simplest agricultural processes.

The last case to be cited of public interest in Eglinton methods is that of public school teachers in different parts of the State who have visited the school for the purpose of gaining knowledge for use in their own districts. All our public school teachers are alive to the value of outdoor teaching in such subjects as geology, geography, nature study, botany, etc. One of the finest object lessons in this respect in the neighbourhood of Bathurst is the Eglinton school-gardens, and several teachers in the district who have seen Eglinton methods, are availing themselves of the opportunity for instilling into the minds of their pupils a love for farm life and a knowledge of farm work.

PUBLIC SCHOOL, EGLINTON.

(Bathurst Award.)

A REPORT UPON THE METHOD OF TEACHING AGRICULTURE IN OUR STATE SCHOOLS.

Being an Account of the Actual Work done at the Numba Public School, under J. D. Lord, Teacher.

Theoretical Teaching.

The theoretical part of the work is given in school under the headings of Object Lessons, and Nature Talks or Nature Study. These lessons are often actually given under a tree, in the garden, or in the school grounds: according to subjects treated, in other cases. The lesson is given in school and a revision takes place in the grounds. Another method is to allow the whole class to question the teacher upon the subject, and he supplies answers and any information which he thinks the pupils may have failed to elicit from him. Of course, this is only the theory. The subjects taught are not always taken in their proper sequence. The seasons are allowed to affect their order. For instance, maize is not treated during a winter quarter, nor Swede turnips during the early summer months. Therefore, in the building up of the programmes, a teacher will find it necessary to take into consideration the time of year, as well as the subject upon which he intends to speak to his pupils. But, in spite of this, there are certain lessons which must come first, as forming the foundation of the whole subject. Children must be taught to observe and to think for themselves, and to reason out the results. This is true education. Cramming is not. What can a lad understand from a lesson on geology unless he has the sample of rocks before him? Take, for example, the air-plant and *speak* to a class about its roots. Such a method is cruelty. But just hang an air-plant in the school before your class and say, "Now boys, who can give me the best description of that plant?" The children will know and understand the lesson which is given after their descriptions far better than if ten times the energy had been spent in many theoretical ideas on the board.

Importance of the Subject.

Now for the subject of Agriculture. It is always well to impress upon the children the following important facts:—(*a*) The nobleness of agriculture; it has the stamp of Divine approval; man in his earliest period was an agriculturist. (*b*) The business or science of agriculture is at the root of all wealth; every nation, however great or small, depends upon the soil. It is the source of all vegetable life. Man is a vegetarian in a great measure, consequently must be supplied with vegetable produce of some kind, in some form or other. The land is the chief supporter of animal life. Our meat, mutton, pork, poultry, not to mention any of our bye-products, such as leather, wool, tallow, eggs, honey, bacon, etc., are all derived from the soil. Therefore, we are compelled to admit that the land is the richest and most wealthy mine in the world. Its supplies are simply inexhaustible, and its markets are equally permanent and sure. Therefore, this headlong rush for "City life" and "Government employment" is to be discouraged, because the land is much to be preferred as affording a means of securing an honest, healthy living, with comfort and prospective affluence. But, in addition to this, it builds up men and women morally and physically stronger, healthier, and more suited to transmit to their offspring those invaluable and inestimable qualities of sound, healthy constitution, backed up by pure blooded life on the part of our parents. "Go on the land boys! and be noble, independent men!" is a good motto for our schools.

Cultivation.

The Soil.—Life is contained in the soil. Various grasses indicate the various soils. The different kinds of soil will produce different results. Sheep country and agricultural soil differ; results of simple experiments enable us to tell just what the land will produce best, and what ingredients are required to make it produce other crops. Chemistry assists us here. A simple analysis can be performed by using a rule, scales, and a big tumbler and precipitating glass; a graduated tube will answer very well. By this means we can classify the soils—

(*a*) Stony and gravelly soils.
(*b*) Rich mould from vegetable deposits.
(*c*) Sandy.
(*d*) Clay soils.

Breaking up of the Soils.—This work is done by the pupils, and the reason for inverting and breaking clods pointed out; why some weeds may be buried and some burnt. During the lesson the pupils are allowed to talk and ask questions, which are answered with reasons. After the preparation of the soil, sowing of the seeds is the next process, and this is always preceded by a testing of the seeds to show how they germinate.

Seeds.—Peas, beans, and such like are sown in rows with and without manure, to show the result of the various manures. They are hilled and attended to by pupils who are supplied with seeds for home treatment in like manner. As a result of his own efforts, a little lad, aged 8, was supplied with some butter beans, and he brought his master a present of his first gathering of most beautiful crisp beans. Other lads, also, bring various samples as a result of their homework.

Cabbage, cauliflower, radish, and turnip seeds are sown by the children, and they then repeat their lessons at home. The planting-out process in like manner is repeated in their homes.

Other crops.—In addition to vegetables of all kinds cereals are grown, and a small patch for experimental purposes is kept going with successive crops of various kinds. As a proof of the interest surrounding the "home garden" method, a person informed the master that he intended to devote a piece of land to the cultivation of various crops to form a trophy for the Shows along the South Coast next year.

Fruit Culture.

Pruning, budding, and grafting are taught to the boys.

Jams, etc.

The girls generally get an afternoon with the teacher's wife when making jams, jellies, preserves, &c.

Flowers.

This is really the girls' department, but, as with the boys all pupils are included in these lessons. The flowers are grown in tins. Each tin is painted green, and each girl's name is neatly printed upon it by one of the boys, whilst a label bears the name, etc., of the flower. The girls from time to time receive presents of seeds, bulbs, or cuttings for their home gardens, and the school is seldom without a good supply of flowers. It is found that the flowers have a most pronounced effect for good upon the tone of the school. The lower section draw them on their slates, using coloured crayons—merely to fill in a few spare moments—whilst from time to time the upper section paint them in water colours, or design a border from the leaves, stems, buds and flowers. At other times they form the subject of our "Nature talks," the children taking the flowers home, where they often repeat that which they have been taught at school:—

"He who careth for the flowers
Will much more care for you."

Then there are lessons upon insects and insect pests. All insects are not pests. This thought is soon found out by the children when they watch the little birds feed upon "pest-infected plants." Of course, no lessons upon "pests" would be complete without one upon spraying, insecticides, fumigation, etc.

Plan of Instruction.

A synopsis of actual instruction for half a year upon the subject of agriculture to children, is as follows:—

No. of Lesson.	Subject.	Synopsis of Lessons.
1	Agriculture ...	Introduction, Dignity of Labour, Knowledge of elementary Chemistry, Botany, Meteorology and Book-keeping necessary to secure success. Industry and practice will lead to prosperity.
2	The Soil	Life in the soil—grasses and soils—simple analysis of soil. Formation of soil. Vegetable matter.
3	,, ...	Mould, clay, peat, soils, and plant life.
4	Preparation of Land.	Tools. Hoe, spade, plough. Compare them, and why we turn up the soil. Depth of soil. Subsoil: Air. Frost, its effect upon land.
5	Seeds..........	Good and bad Tested. Air, light and heat, and moisture necessary. How the roots and leaves nourish plants.
6	,, ...	Air and soil with regard to plant life. The roots, their functions. The leaves and stems, their functions. Increase of grain or seeds. Nature and man assist each other.
7	Crops............	Sowing and cultivation of summer crops: Maize, pumpkins, potatoes, marrow, squash, melons, cucumbers—Harvesting or marketing of them.
8	,, ...	Wheat, rye, oats, barley, sorghum, mangold, turnips—from seed to market.
9	Rotation of Crops	The effect of manures. Fertilisers, Practical illustrations, with various manures.
10	Fruits	(a) Budding. (b) Pruning. (c) Grafting. An evening lesson, generally taken separately after school work.
11	,, ...	Harvesting: Uses, home, jams, jellies, dessert, profit, marketing, pigs, and poultry.
12	Flowers.........	Their uses, adornment, and profit. Sale in various forms. Scents for sale later on. Home made perfumes.
13	....	Profitable occupation on mixed farming. Agriculture, poultry, pigs, bees, cow; ask for their products. How much must the farmer purchase to supply his requirements?
14	Milk	How to milk. Cream. Butter, churning, salting and packing are all treated.

By means of a glass churn the smallest child in the school can assist in the churning. The various processes which the cream undergoes is clearly visible to all, and the lesson is only a delightful pastime. The little ones are allowed to talk, and the interest is sustained by allowing each to do something. Further, it is noticed that boys and girls of retiring disposition throw off their shyness, and become active participators in the work. The whole success depends upon the method of the teacher; and in the hands of a tactful teacher, the work of agriculture in our Public Schools will be easily introduced, and prove a help to both teacher and scholars, and in a very short period of time be a source of great blessing and prosperity to thousands in this young and growing State.

Arbor Day.

The objection is often raised by teachers "that many school grounds are quite unsuitable for gardening." Then if the grounds are so bad let them be treated as miniature nurseries, and when the plantlets are ready have an "Arbor Day" on the street, in the park, or upon the cricket grounds.

Our American cousins set us a good example in this "Arbor Day" movement, and why should it be allowed to die out with us? If all other places fail, an afternoon "Arbor Day" at some of the pupils' homes might be arranged, and by so doing there is not the slightest fear but the teachers will have the hearty co-operation of parents and friends. By having "Arbor Day" upon the "cricket field," "show ground," "park," or "street," teachers enlist the sympathy of the whole of their respective districts, their work is brought into touch with all concerned, and the parents, children, and public are identified with the movement. During the preparation of the plots, or when planting the trees or shrubs, some qualified local person could be induced to make a few concise instructive remarks about the growing of trees, their uses, etc., etc.

Many

Many teachers are in favour of planting school grounds with an assortment of fruit-trees. Of course soil, climate, and position have to be studied. And here again is where the good man shows forth. He is able to show by a judicious selection of trees, and attention to them, what can be made of the very worst piece of ground, and it is in such places that our lads need to be trained, viz., where they can be taught to surmount difficulties. By having a good supply of fruit-trees, the teacher will be able to give practical lessons at the proper time in pruning, grafting, and budding, and the girls can be taught "jam," "jelly," and "preserve" making. Should the teacher not feel equal to giving a lesson on certain sections of the work, he could possibly get some qualified person in his neighbourhood to supplement his own instruction. Failing this, he should set to work and gain his own experience by practice which, after all, is the grand teacher.

WEST LEICHHARDT SCHOOL GARDEN.

Methods employed.

At the West Leichhardt Superior Public School, Sydney, special attention has been paid to the teaching of agriculture under the direction of the Head-master (Mr. Wenholz) and his assistants (Mr. Dash and Mr. Patton). The garden in which the practical work is carried out covers an area of 1 acre; it is divided into experimental plots of various sizes, the rows being lettered and numbered for convenience of reference. As a preliminary, the whole of the ground was trenched to a depth of 2 feet, and a large amount of stable manure was dug in. The whole of the work was done by the pupils, and no monetary assistance was received from the Education Department. To supply tools, the pupils held "penny concerts," and when special work was being undertaken, boys willingly brought tools from home for the purpose. The garden tools used are always of the best quality and *full size*; the work is serious, and cannot properly be carried out with toys.

Seeds and plants were obtained from the Agricultural Department, from the Botanic Gardens, from the State Forest Nursery at Gosford, and also by means of school entertainments. The garden is divided into two parts, one being devoted to flowers, the other to plants of more economic value. In the flower garden, special attention has been paid to roses and chrysanthemums; bouvardias and annuals of various kinds are also grown.

In the economic section, a list of the plants which are growing or have been cultivated in their proper season gives a good idea of the extent of the work:—

Fodder Plants and Grasses—
 Lucerne, clover, sainfoin, salt bush, perennial rye, stipa macantha, Paspalum dilatatum, rib grass.

Oil Plants—
 Olive, rape, sunflower, linseed (flax).

Fibre Plants—
 Flax, hemp, cotton, jute, ramie fibre, sisal hemp, bowstring hemp.

Fruits—
 Guavas, passion-fruit, loquat, ly-chee (Chinese raisin), date-palm.

Cereals—
 Wheat, oats, barley, rice, maize.

Legumes—
 Peas, beans, cowpeas, lentils.

Sugar Plants—
 Sugar-beet, sorghum, Canadian sugar-maple.

Vegetables—
 These vary with the season. At the present time there are growing:—Lettuce, parsnip, carrot, spinach, beetroot, turnip, swedes, kohl-rabi, butter beans, broad beans, eschalots, cauliflower, peas, etc.

Economic plants—
 China tea plant (*Thea Bohea*), chicory, tobacco, capsicum, ginger, cotton, arrowroot, broom millet, pea-nut.

Economic trees—
 Eucalypts (Tasmanian blue-gum, West Australian karri, sugar gum, lemmon-scented gum, tallow-wood, ironbark, and others), North American red wood, cedar, the bamboo, the mulga and the wilga, the golden wattle of South Australia.

In addition to the foregoing, there are a number of trees for shade purposes, etc., the Moreton Bay fig and the pepper-tree.

Methods.

Three lessons are given to the pupils each week, one being practical. The theory lessons deal with the principles of Agriculture, and Botany as applied to Agriculture. The theory deals with the nature and composition of soil, the why and wherefore of tillage, the necessity for manuring, the various kinds of manure, their composition and mode of application. The instructors hope to, eventually, take the highest class through a course of practical agricultural chemistry; at present the conveniences for such a course do not exist. The teaching in Botany supplements the theory of agriculture by revealing the nature of the plant, the foods it requires, and the method in which the food is assimilated. The teachers have purposely avoided what may be termed scientific Botany, the nomenclature of which repels young minds, and older ones, too. Unless under very exceptional circumstances, a subject is not dealt with in which the object cannot be placed before the children so that they may see and handle it. Thus when commercial fertilisers are spoken about samples are on the table for the boys to examine, and as far as possible the teaching is made "real." For this purpose the pupils were taken to the Hawkesbury Agricultural College, and the trip proved both stimulating and instructive. Farm operations are taught

in the open air, and the reason for the operation is always sought. "Why we dig?" "Why we mulch?" The manual dexterity, good in its way, becomes the supplement of the intellectual development. This idea has been carried still further in the planting of seeds. A crop is not the only thing looked for, but the relative yield when the rows are treated with different manures. The teachers treat a given number of drills with one description of fertiliser, leave a certain number unmanured, vary the fertiliser, and so on. In this way the theory lesson as to the different kinds of food a plant requires is proved in practice. Each pupil keeps what is called a "Garden Book," in which particulars of planting are entered, the state of the soil, the kind of manure, etc. He then observes for himself the date of germination, of flowering, etc. Thus the history of the plant from its dormant seed to its harvesting becomes instructive, especially in developing the observing powers of the pupil.

In addition to the foregoing there are "garden chats" in the open air upon plants which have any marked peculiarity in their growth or history, *e.g.*, ramie fibre, pea-nut, cotton plant. If this is not done the pupils may get out of touch with the plant during the period of its growth.

Pupils are at liberty to wander at will among the garden beds, no restriction being placed upon them. Many bring their parents along to explain the working of the garden, and exhibit a pardonable pride in the results achieved. Garden work is carried on before school and during the mid-day recess, and the number of volunteers is always in excess of the requirements of the work—all positive proof of the interest that the pupils take.

Results.

The results achieved are such that it is impossible to tabulate them.

They will, it is believed, display themselves in their influence upon the character and aspirations of these future citizens.

Those results which have forced themselves under notice are the following:—

(1) A respect for the property of others. Beautiful flowers bloom in private gardens in the neighbourhood of the school within easy reach of the passer-by—they are untouched by the school boys, and this is largely to be attributed to the educative influence of the school garden.

(2) The development of a "public spirit." A feeling of proprietorship has been engendered, so that flowers bloom and fruits ripen untouched by the individual, but existing for the good of the little community. When this spirit becomes widespread the need for iron fences and bolts and bars to our public parks and gardens will have disappeared.

(3) School life becomes no longer irksome. The so-called dull boy at mental work is frequently the most practical and smartest at outdoor work. He loses that sense of mental inferiority which continually being at "the bottom of the class" brought about, and thus can more than hold his own in the general work of the school.

(4) A spirit of *esprit-de-corps* is engendered. The boys value their school highly, and each one is a self-appointed policeman who watches it with care when it is left unattended at vacation and other times.

(5) The dignity of labour is taught. Neither teacher nor pupil deems it derogatory to take off his coat and delve.

(6) Pupil and teacher being brought into close contact, understand each other, the teacher loses his "drill sergeant" methods, and the pupil looks upon him as a friend from whom information can readily be obtained.

(7) Pupils, almost without exception, have gardens of their own in which they put into practice the lessons they have learned at school. Parents frequently invite the staff to visit their homes in order to see their boys' gardens, and speak in glowing terms of the good influence which is being exerted.

(8) The artistic sense is cultivated.

(9) The keen observant interest that is taken develops the thinking powers and common-sense methods, and these react upon other school subjects which are not correlated with agriculture.

These are, in brief, the mental and moral results which have been achieved; but there is, in addition, that practical acquaintance with the subjects which in itself constitutes a technical education. Already cases have occurred in which boys have gone direct from school "on to the land," and, judging from conversations the teachers have had, many more would take up the work if the opportunity presented itself.

It may be remarked, finally, that the garden is an object-lesson in "self-help," and conclusively shows that, under proper direction, the jibe so often levelled against our people of "leaning on the Government" will be a thing of the past. The boys of to-day are the citizens of to-morrow, and on the teachers rests much of the responsibility of seeing that they are properly equipped for carrying out the duties of citizenship.

ELEMENTARY AGRICULTURE IN SCHOOLS.

Experience of R. A. Irwin, Teacher, Superior Public School, Granville.

The increased activity now being manifested in this State in the agricultural industry, owing to the beneficent rains which recently fell in most parts of the State, justifies the prediction that the next harvest in New South Wales will be the largest on record. The results of a bountiful harvest will be felt by all classes of people, an enormous stimulus will be given to trade, and our credit in the home market will be re-established.

The Government of the day is wisely encouraging settlement on the land, to develop our great natural resources, and to attract a desirable class of settlers to our shores.

It is vain to imagine that manufactories will thrive in our sparsely-populated State; our only road to permanent national prosperity lies in settling on our fertile lands a contented race of producers. When this is accomplished, manufactures will follow as a matter of course.

All

All other great nations have passed through those stages, and we are not likely to prove an exception to the rule.

To give effect to the policy I have indicated, the State Governments have done splendid work, through the Department of Agriculture, in establishing the Agricultural College at Richmond and the various experimental farms in our State.

It remains for every patriotic citizen to assist in this great work, and no one is more favourably situated to supplement the efforts of the Government than the teachers of public schools.

I have long held this opinion, and, consequently, have devoted considerable time and energy to the teaching of elementary agriculture. The chief object of this article is to persuade others to take up the work.

Perhaps the chief difficulty is in qualifying one's self for the task; but let no one imagine such difficulty is insurmountable. A natural taste for the work is most desirable; but even those who lack this will find that the cultivation of the soil and the growth of plants will develop a fascination for the work which will not easily die out

The first attempts may be crude—they may even be failures—but teachers who love their calling are not deterred by failure.

The Agricultural College is open to those who seek knowledge, and excellent text-books are easily available. In the case of country teachers, visits to neighbouring farms can be made, to observe and to learn. One of my chief pleasures as a country teacher was to visit farms close by, to discuss operations in agriculture with the tillers of the soil. The information thus obtained I materialised in the school.

At the Nowra Superior Public School (1898–1901) I conducted a course of lessons in elementary agriculture, comprising the following programme:—

(*a*) The soil; its origin and formation.
(*b*) Preparation of soil for crops.
(*c*) The germination of seed.
(*d*) How plants feed.
(*e*) The conservation of manure (compost heap), and its application to soil.
(*f*) Lime, and its application to soil.
(*g*) The treatment of soil during prolonged dry weather.
(*h*) Transplanting.
(*i*) Rotation of crops.

Each subject was treated as a lesson in the school-room, and was followed by practical instruction in the experimental plot in the playground The results were very gratifying. A rather poor patch of soil was converted into a pleasant vegetable garden, surrounded by a border of choice flowering annuals.

The above course was succeeded by another in bee-culture. Previous to appointment to Nowra, I had acquired considerable experience in the management of bees in the apiary of one of the most experienced bee-keepers of the State at Cowra.

The utmost interest was maintained throughout this course. The inner workings of the hive, as revealed for the first time to the pupils, from the laying of the egg to the emergence of the fully-developed insect, the arrival of queen bees by post to Italianise the hive, and, finally, the extraction of the honey by machine, all served to make the instruction intensely popular.

A third course was given in poultry-farming, and, I believe, awakened an increased interest in that important industry which has proved of value to the State.

I trust that I am not assuming too much when I say that I think I have indicated, no matter how imperfectly, how teachers can assist, by creating in young and plastic minds an interest in healthy, rural, and profitable industries, to develop our natural resources. And, lest I may be classed as a mere theorist, I shall give an illustration of some good resulting from this special work. At the invitation of the Nowra School of Arts, I gave a lecture on "Bees and their Management" in the local town-hall. At the conclusion of the lecture, I announced that I should be pleased to transfer from a gin-case hive to a bar-frame hive any hive belonging to any person present. Three applications were made, and I carried out the work. One owner had two hives, from which he got little or no returns. Before I left Nowra the owner had, under the new system, increased his bees to eight hives, and was selling honey to the local stores.

At Wollongong, my next appointment, I continued the work in elementary agriculture, and conducted a series of experiments in the growth of the potato, to demonstrate the value of applying commercial fertilisers, and to test the results from "hilling" and "non-hilling."

The exhibits at the recent Royal Agricultural Show from Public Schools amply prove that excellent work in teaching agriculture is being done by other teachers, and I hope that the movement will extend throughout the State.

HAWKESBURY AGRICULTURAL COLLEGE, RICHMOND, NEW SOUTH WALES.
(Front View.)

CHAPTER XLIX.

Secondary Agricultural Education in New South Wales.

[J. W. TURNER.]

DEPARTMENT OF AGRICULTURE, SYDNEY, NEW SOUTH WALES.

Hawkesbury Agricultural College and Experimental Farm, Richmond, New South Wales.

(From the latest Annual Report.)

OFFICERS AND STAFF.

Principal	H. W. Potts, F.C.S., F.L.S., J.P.
English and Science Master	C. T. Musson.
Lecturer in Chemistry and Physics	C. Potts, B.A.
Lecturer in Veterinary Science and Practice	S. C. Pottie, M.R.C.V.S.
Registrar	S. F. Adams.
Assistant Registrar	M. L. Myers.
Orchardist	J. Alford.
Dairy Instructor	P. H. Suter.
Overseer of Works and Foreman Carpenter	A. Brooks.
Farm Foreman	G. Cobb.
Experimentalist	G. Marks.
Pigs, and Bacon-curing	Geo. Daley.
Engineer	C. H. Ausburn.
Poultry Expert	D. S. Thompson.
Blacksmith	D. H. Reay.
Sheep and Wool Expert	A. Hawksworth.
Housekeeper	Mrs. Richardson.
Medical Officer	J. Gibson, M.D.

INTRODUCTION.

THE Hawkesbury Agricultural College and Experimental Farm is situated on a gentle slope overlooking the town of Richmond, about 1 mile from the railway station, and in close proximity to the Kurrajong Heights and Blue Mountains.

Richmond is 38 miles from Sydney, with which it has a service of three passenger trains daily.

The farm comprises an area of 3,500 acres of land suitably fenced and subdivided. About 1,000 acres are under cultivation.

Special care has been taken to make the farm equipment ample for the work of the Institution, and of the most modern type. It consists of large and commodious farm buildings, lecture hall, class-rooms, laboratories for practical work in chemistry, physics, botany, entomology, and bacteriology.

Experiments.—100 acres of the Farm are set apart and laid out in small plots, and series of experiments and tests with roots, grasses, cereals, manures, and methods of cultivation are systematically conducted from year to year under the direction of an experienced agriculturist.

The dairy farm is well stocked with suitable breeds of dairy cattle, and provision is made to teach dairying in all its phases. The dairy is fully equipped with the most recently-designed appliances for the treatment of milk and the manufacture of butter and cheese.

The piggery contains seven of the best breeds of pigs. The boars and sows are representative of the various types, and have been selected and imported from the best strains of blood in England and America. Bacon-curing is carried on extensively for the instruction of students.

The horticultural department includes a fully-stocked orchard, a cannery, vegetable garden, and other accessories required to give practical instruction in fruit-growing, preserving, and packing, also market gardening.

The poultry section is replete with pure-bred examples of the best varieties of table and laying fowls, ducks, turkeys, and geese. The equipment includes the best forms of incubators, brooders, &c. Ostrich farming also forms a part of this section.

The library contains about 3,000 volumes of books, pamphlets, &c., chiefly relating to agriculture and its allied industries; history, biography, science, and fiction are also represented. It is open for reference and consultation daily by staff and students. Books may be taken at suitable intervals under the supervision of the Librarian.

The reading-room is replete with all the leading daily and weekly newspapers of the Australian States as well as the best technical, agricultural, and live stock journals published.

The gymnasium is well lighted and equipped with all the appliances for physical culture. It is also used as a concert hall, and is provided with a piano.

Recreation

Recreation grounds are provided for football and cricket, also two lawn tennis courts.

A rifle club is formed at the college with sixty rifles, and the requisite rifle range, butts, and targets are on the Farm.

A branch of the St. John's Ambulance Society has been formed to teach first-aid to the sick and wounded, and is under the direction of the medical officer.

The college is a meteorological station in connection with the Government Observatory, and is furnished with the principal instruments and apparatus for meteorological observations and records.

An electric lighting plant is provided and the whole of the college and farm buildings are well illuminated.

A steam laundry is provided.

Steam engines, oil engines, electric motors, and electric pumps are used daily.

PROSPECTUS.

Objects of the Agricultural College and Experimental Farm, and Conditions under which Students will be Admitted thereto.

Objects of the Institution.

The primary object that the Department of Agriculture had in view in establishing the above-named College and Farm was to teach the science of agriculture and the various other sciences connected therewith, and their practical application in the cultivation of the soil and the rearing and management of stock, and qualify its students, as far as possible, for the profitable management of farms, dairies, orchards, or vineyards, either as proprietors or paid managers of same.

To this end it is deemed indispensably necessary that every young man who may be admitted to the College shall learn to labour and become proficient in the use of the various implements of husbandry employed on the farm, and in the management of the various kinds of live stock connected therewith. Each student, therefore, will be required to perform a certain amount of labour.

One other object held in view in establishing the Farm is the conducting of experiments in various branches of agriculture, but more particularly in respect to the comparative value of the various artificial or commercial fertilisers, rotation of crops, and growth of plants suitable to our climate, but not generally adopted in our agriculture.

In a word, it is designed to carry on experiments in each department of agriculture for the purpose of improving its processes and enhancing the value of its products.

Students will have access to the experimental grounds and all other parts of the Farm, under such rules as may be submitted by the Principal from time to time, and approved by the Minister.

The Curriculum.

The course of study will comprise the principles of agriculture, chemistry, botany, vegetable pathology (including the use of the microscope), entomology, veterinary science and practice, mechanics, elements of surveying, bacteriology, meteorology, farm book-keeping, besides all kinds of practical work on the Farm, instructions in field operations, the use of farm implements and machinery, all dairy operations, necessary carpentry and engineering required on a large farm, the management of stock, bees, and poultry, and all branches of gardening and orchard work as shown in the syllabus.

The course will extend over two years, or four sessions.

Any student entering the College, except at the commencement of the January session, shall engage in practical work only during that session, and at the commencement of the next academic year enter upon his College course for his diploma.

Conditions of Admission.

Age.—Each candidate for admission must be over the age of 16 years.

Parents and guardians of students under 21 years of age will be required to give an undertaking that they will at all times conform to the rules and regulations for the management of the College and Farm, and students over the age of 21 years shall give a similar undertaking.

Applications for admission of students will be received by the Director of Agriculture or the Principal at any time, but a student will be selected for appointment to a vacancy according to his qualifications, as follows:—

1. By producing his certificate of having passed the Senior or Junior University examination; candidates passing either of these examinations will be admitted in the order of merit.
2. Failing one of the above certificates, applicants must supply a certificate showing a fair competency in Reading, Writing, and Arithmetic.

Physique and general aptitude for College work will be considered in conjunction with the candidate's educational attainments.

Each applicant must produce a satisfactory testimonial as to character from his last teacher or employer, and a medical certificate from a duly qualified and registered medical man as to his state of health.

Forms of application for admission to the College may be obtained from the Director of Agriculture, Sydney, or from the Principal.

Fees and Deposits.

A fee of £25 per annum, payable half yearly in advance, will be charged for the maintenance and education of each resident student; and if after the expiry of one month from the date of the payment of this fee an enrolled student fails to put in an appearance at the College, he shall then be considered disqualified, and the fee paid shall be forfeited, unless he can satisfy the Minister that his absence was due to some sufficient cause.

A

A deposit of £3 must be paid in advance to cover laundry expenses, damages, &c. The laundry work is done by contract, and each student is charged for the washing he has had done during the session. The damages to College property are charged to a general fund, and the total amount is divided equally among the students in attendance at the time, and a proportionate amount will be deducted from each student's deposit. An account is sent in at the end of each session for the laundry and other expenses incurred, and on this being paid the deposit is made good. When a student leaves the College it is necessary to pay his account, and the deposit of £3 is then refunded.

Fees of 10s. for medical attendance and 4s. for medicine are also payable in advance. These fees are paid by all students whether the attendance and medicine are required or not, but no matter to what extent they are required no further charge is made.

Upon a student entering the College, the fees and deposits for the first session are as follows:—

	£	s.	d.
Education and Maintenance fee	12	10	0
Medical Fee	0	10	0
Dispensing Fee	0	4	0
General Deposit	3	0	0
	£16	4	0

Non-resident students may be admitted on the approval of the Minister. The fee for these students will be £2 2s. per annum, payable half-yearly in advance.

Special Courses and Special Fees.

A limited number of non-resident students, male and female, may be received at the College for a term of six months for instruction in the following special courses:—

Poultry and Bee Farming.
Dairying in all its branches.
General Orchard Work.
Pig Farming and Bacon-curing.

The fee for any special course shall be £2 2s., payable in advance.

A special course cannot be taken during the currency of the general College course.

A limited number of special course students may be admitted to residence on payment of full College fee.

Certificates of competency will be awarded, subject to examinations in theory and practice.

Bursaries.

Six bursaries of £25 a year each may be awarded by the Minister for Mines and Agriculture, each year, to those students whose parents' circumstances and their own aptitude and qualifications render them deserving of this assistance. Special application must be made for these bursaries before the commencement of the College term.

Medals and other Prizes.

The Minister's Special Prize for best farm student.

The Principal's gold medal to the dux of the College.

The Burdekin silver medal presented to each student upon taking his diploma. (The late Sydney Burdekin, Esq., arranged that this tangible expression of his appreciation of the work of this Institution shall be available for all time.)

The Burdekin book prizes; also a number of book and other prizes presented by the parents and friends.

Student's Outfit.

Each resident student will require to provide himself with the following articles:—

Two suits working clothes.
One suit for Sunday wear.
Two pairs suitable boots and one pair slippers.
Hair-brush and comb.
One clothes-brush.
Four sheets.
Three pillow-slips.
Six strong bath towels.
Two large aprons for the chemical laboratory.
Set of mosquito nets.

All wearing apparel, bed linen, &c., must be distinctly marked with the name of the student, otherwise it will not be taken to the laundry.

College Sessions.

The academic year will be divided into two sessions:—

The first session commences 23rd January, and ends 22nd June.
The second session commences 23rd July, and ends 22nd December.

Notice of leaving College.

In the event of any student desiring to leave the College before the expiration of the complete course, one month's notice in writing must be given to the Principal, or, in default, a session's fee will be incurred, and be recoverable.

Discipline.

Each student shall conform to the rules and regulations for the time being in force for the government and management of the College, under penalty of expulsion, or of such lesser punishment as the Principal may impose.

Library.

Students may obtain books from the College Library upon application to the Librarian. Books damaged or lost will be charged in full to the student responsible.

REGULATIONS.

1. College students will be required to work on alternate days on the Farm and in the class-rooms and laboratories as directed.

2. During the first year of the course the following subjects will be studied :—

Practical Agriculture, Principles of Agriculture, Practical Chemistry, Theoretical Chemistry, Botany (including Vegetable Pathology), Arithmetic and English, and Surveying.

3. An examination for the first year's certificate will be held at the end of the student's first year, to get which he must obtain 50 per cent. of the maximum marks in the following subjects :—

Principles of Agriculture, Practical Chemistry, Theoretical Chemistry, Botany; and 75 per cent. in Practical Agriculture.

4. During the second year the following will be the subjects of study :—

Practical Agriculture, Principles of Agriculture, Practical Chemistry, Theoretical Chemistry, Entomology, Veterinary Science and Practice, Book-keeping, Botany (including Vegetable Pathology), and Mechanics (including Heat), Bacteriology, and Meteorology.

5. The examination for the diploma will take place in December each year, and to obtain a diploma a student must pass examinations in—

1. Practical Agriculture.
2. Principles of Agriculture.
3. Practical Chemistry.
4. Theoretical Chemistry.
5. Botany (including Vegetable Pathology).

And any three of the following subjects :—

6. Applied Mechanics and Heat.
7. Entomology.
8. Book-keeping.
9. Veterinary Science and Practice.
10. Surveying.
11. Sheep and Wool.

The paper in Surveying is set at the first year examination and is available for the diploma. In order to obtain the diploma the student must secure at least 75 per cent. of the General Conduct marks and 75 per cent. of the maximum marks in Practical Agriculture, the standard for a pass in all other subjects being 50 per cent.

6. The diploma will not be granted to students obtaining less than 75 per cent. of the General Conduct marks, and all claim to medals, prizes, and certificates for the current session will be forfeited.

7. Examinations in all the subjects of the College course will be held weekly on Saturday forenoons, and at such other times as may be deemed necessary by the teaching staff, and approved by the Principal.

8. The Principal will allot to officers their respective duties in the College and on the Farm, and will have power to frame rules and regulations for the guidance of the students and all engaged in the College and on the Farm. Such rules and regulations to be subject to the approval of the Minister.

Working Hours.

The hours of labour on the Farm and in the workshops are to be 48 actual, as follows :—

Monday	7 to 11·30 a.m., 1 to 5 p.m.,	8½ hours.
Tuesday	7 to 11·30 a.m., 1 to 5 p.m.,	8½ „
Wednesday	7 to 11·30 a.m., 1 to 5 p.m.,	8½ „
Thursday	7 to 11·30 a.m., 1 to 5 p.m.,	8½ „
Friday	7 to 11·30 a.m., 1 to 5 p.m.,	8½ „
Saturday	7 a.m. to 12·30 p.m. ...	5½ „
		48 hours.

The above hours shall apply only to the usual routine work of the Farm. During the time of sowing and harvesting, such instructions as are necessary will be issued by the Principal.

The work list is prepared daily at noon and exhibited in a case, when each student can ascertain the section of the Farm he has to commence work at the following morning.

The list is prepared for students who are going through the full college course, and each student is thus provided with specific training and practical work on every section of the Farm.

This is the special feature of the College. Every student is each alternate full day on the Farm, and the list is so designed as to give each student three days in a week on each section, *i.e.*, three days on the Farm, and three days indoors engaged in the academic and other subjects, such as scientific. This work-list does not include the students who are engaged on the special courses, as follows :—

Dairy	6 months.	Piggery	6 months.
Poultry	6 „	Experimental plots ...	6 „
Orchard	12 „	Special Farm course ...	6 „

The above courses are chiefly designed to afford students, who have passed through the diploma or full college course of two years, an opportunity of gaining a more intimate practical training on these sections. Further, if a student desires to specialise when starting in life, he is better equipped with the extra training.

ACTUAL

ACTUAL PROGRAMME, HAWKESBURY AGRICULTURAL COLLEGE AND EXPERIMENTAL FARM, 24TH AUGUST, 1904.

Students' Work List.

A. Cow-bails—4·30 a.m., milking and separating.
B. Attend horses—5·30 a.m. and 8 p.m., grooming and feeding.
C. Attend stables during day.

	Students.
Special class, with Mr. Cobb ...	M'Govern; Nicholls; Oakshott; Pinn; Ruitt, Sparks; Thornton; Tuckerman; Wise, Jackson.
With Farm Foreman	Lillyman, R. O.; Elliott; Jones; Monie; Marina; Woodburn; Digby, R.; Digby, T.; Hewlett; Vyner; Wiseman; Lillyman, S. R.; Ousby; Brown, W. T.
" Experimentalist	Williamson, E. P.; Allt.
" Orchardist	Archibald; Gutman: Lindsay; Machattie; Calvert; Rex, A.
" Dairy	Fuller; Lawrie; M'Cormick; Lindeman, R. A.
" Carpenter	M'Donald; Beale, P. N.; Perram.
" Poultry farm	Holthouse; Borthwick; Beeson.
" Ploughman	Kelman; Chapman, N.; Rudd.
" Fencer	Glissan; Pountney.
" Blacksmith	Lee; Grant.
" Engineer	Duce; Ripper.
" Piggery	Martin; Jacobs.
" Vegetable garden... ...	Williamson, N. S.; Joubert; Haydon; Graham.
" Gardener	Atherton; Traill; Maccabe; Hinchcliff.

H. W. POTTS,
Principal.

ACTUAL PROGRAMME, HAWKESBURY AGRICULTURAL COLLEGE AND EXPERIMENTAL FARM, RICHMOND, 31ST JULY, 1904.

Students' Sunday and Holiday Work List.

A. Cow-bails—4·30 a m. and 3 p.m.
B. Piggery—5·30 a.m., 10·30 a.m., and 3·30 p.m.
C. Poultry—5·30 a m. and 3·30 p.m.
D. Engineer—4 p.m. and 6 p.m.
E. Run in horses—6 a.m., and drive sociable.
F. Feed horses—6·30 a.m., and let horses out 9 a.m. Run in and bed down at 5 p.m.

A. Archibald; Atherton; Beale; Beale, P. N.
B. Borthwick; Brown, W. T.
C. Brown, E. D.; Beeson; Chaffey.
D. Chapman, N.
E. Elliott.
F. Duce; Digby, R.; Digby, T.; Glissan; Graham; Grant.

H. W. POTTS,
Principal.

COLLEGE RULES.

1. Students are required to obey the orders of the Principal, teaching staff, and those put in charge of them for the day.
2. Lecture and demonstration hours will be from 8·30 to 11·10 a.m., and from 1 to 5 p.m.; five minutes being allowed between each lecture.
3. In the event of a lecturer being unable to deliver his lecture or carry on a class, the students concerned are to devote their time to such work as the Principal may direct.
4. Students are not to occupy the class-rooms or laboratories, except during lecture hours and evening study, and then under the constant supervision of one of the officers.
5. Students will not be allowed to wear slippers during lectures. They must appear neat and tidy, and no coats may be taken off without the permission of the lecturer.
6. When any student is excused, through illness, from attending any lecture, class, or practical work, he is not to go beyond the bounds fixed by the Principal.
7. Punctuality, order, and quietness are to be observed in the College and on the Farm at all times. Unpunctuality, disorder, and noise will render students liable to lose good-conduct marks, or to be dealt with in such other way as the Principal may determine.
8. Students must attend punctually at all meals, and must appear at the table clean and tidy; quietness and order must be observed. They will lose good-conduct marks if late, unless detained in the College or on the Farm. Students late for meals must be satisfied with whatever the housekeeper can give them.
9. Students (except in cases of sickness) may not be absent without permission.
10. All games are expressly forbidden during the hours specified for lectures or classes. The piano must not be used during class or study hours.
11. Students smoking in bedrooms, or using lights of any description therein other than those provided by the Department, are liable to instant dismissal. The habit of smoking is expressly discountenanced, and is prohibited, except in places set apart for the purpose.
12. Students are not allowed to frequent hotels in the town unless accompanied by parents or guardians.
13. Students may not bring, or cause to be brought, into the College buildings or on to the Farm any fermented or spirituous liquors.
14. Students must not have in their possession firearms of any description.
15. No student is allowed to change his room without permission. At the close of a session senior students will have preference as to the choice of any vacant rooms.
16. Students will not be allowed leave of absence during the session except on important occasions, and with the full consent of their parents in writing.
17. Students may leave the College bounds after 8 p.m., provided their general conduct is satisfactory; but they must be in their rooms not later than 10·30 p.m., unless special permission is granted by the Principal.

18. Each student is required to keep a farm journal from personal observation.

19. Students required to take charge of working horses are to be at the stable at the time shown on the College time-table; and are required to clean and otherwise attend to them.

20. Students required for ordinary farm work are to assemble as indicated on the College time-table, at 7 o'clock a.m. sharp, to receive instructions.

21. Students in charge of animals are expected to treat them in a humane manner.

22. All cases of injury to animals and implements are to be reported without delay to the Principal.

23. Students using tools and failing to return them to their proper places will be held responsible, and any student damaging implements, harness, gates, or other property on the Farm through carelessness or neglect will have to make the same good at his own expense. All such losses and breakages must be at once reported to the Principal.

24. Cows are to be milked by students in turn, as may be directed.

25. It is expected that all students will give timely notice to the Principal regarding the straying of stock, &c., and show generally an interest in the well-being of the Farm.

26. Students are invited to question the workmen on the Farm on matters pertaining to the work, implements, &c.

27. No student will be permitted to enter the orchard or vineyard without the consent of the Principal, unless in charge of one of the teaching staff for educational purposes, or when at work with the orchardist.

28. Students are allowed access to all other parts of the Farm, but they are required not to disturb the stock or leave any of the gates open.

29. Students are forbidden to enter the kitchen or laundry, except on business.

30. Students are cautioned against interfering in any domestic arrangements, and finding fault with the servants. Should there be any cause of complaint they are requested to speak to the Principal upon the subject.

31. Any student incapacitated by sickness and away from duty for more than two days consecutively, must call in a medical man, and if he certifies that the student is in a fit condition to be moved, he must go home to his parents, guardians, or to some suitable place for the purpose of obtaining proper attention, unless special permission to remain be obtained from the Principal. Although every attention will be paid to sick students in cases of sudden illness, it must be distinctly understood that the Department does not bind itself in any way to provide nursing and medical comforts.

32. All students must attend Divine Service once each Sunday.

33. No student is allowed to bring any horse, dog, or other animal to the College or Farm.

34. Visitors are not allowed to inspect the buildings or attend meals without permission from the Principal.

35. Complaints, arising from any cause whatever, are to be made to the Principal.

36. Any student who is guilty, either within or without the College, of profane, immoral, or insubordinate conduct, or who after admonition wilfully breaks any of the rules of the College, or persistently neglects his studies, is liable to dismissal by the Principal.

37. The Principal may, at the close of any session direct that any student whose retention is likely to be unprofitable to the student himself, or injurious to other students, or prejudicial to the discipline or the reputation of the Institution, be not permitted to return, and therefore such student's name shall be removed from the College roll.

38. No appeal against the decision of the Principal will be entertained in the case of any student being dismissed for an offence against these rules.

39. The fees paid by any student expelled from the Farm for any offence against the regulations will be forfeited, irrespective of the period of the Farm term.

COLLEGE LECTURERS.

Agriculture and Allied Subjects	The Principal, Mr. H. W. Potts, F.C.S., F.L.S.
Bacteriology and Dairy Science	
Conservation of Fodders, Live Stock, and Pig Farming	
Theoretical Chemistry	Mr. C. Potts, B.A.
Practical Chemistry	
Surveying and Mensuration	
Applied Mechanics and Heat	
Agricultural Engineering	
Agricultural Botany	Mr. C. T. Musson.
,, Pathology	
,, Entomology	
,, Meteorology	
Arboriculture	
Farm Book-keeping	
Arithmetic and English	
Horticulture	Mr. J. Alford.
Dairy Farm Management	Mr. P. H. Suter.
Butter and Cheese Making	
Refrigeration	
Special Fodder Crops and Experimental Work ...	Mr. G. Marks.
Manual Training, Construction of Farm Buildings, Silos, Fences, &c.	Mr. A. Brooks.
Poultry and Ostrich Farming	Mr. D. S. Thompson.
Sheep and Wool	Mr. A. Hawksworth.
Bees and Bee Culture	Mr. A. Gale.
Veterinary Science and Practice	Mr. S. C. Pottie, M.R.C.V.S.
First Aid to Sick and Injured—St. John Ambulance Society	The Medical Officer, Dr. J. Gibson, M.D.

SYLLABUS

Syllabus of Instruction.

Agriculture.

The soil and methods of cultivation for various crops; ploughing, subsoiling, and drainage.

The use of implements of all kinds in the treatment of soil, harvesting of crops, and preparation of produce for market.

The management of horses, cattle, sheep, Angora goats, pigs, poultry, and ostriches.

The use of manures of all kinds for various classes of soil and crops.

The conservation of fodder; hay-making, stacking, and thatching; ensilage by means of stacks, overhead and pit silos; storage of root crops; storage of grain and treatment for weevil and pests.

Elementary carpentry and blacksmith's work; erection of farm buildings and commonplace repairs to buildings, fences, implements, harness, &c.

Orchard Section.

General principles of fruit culture, including—

Selection of soil; preparation and cultivation of soil for various classes of fruit-trees; cultivation; manuring; pruning; harvesting; packing; preservation of fruits by drying, evaporating, crystallising, canning, pulping, jam-making, &c.; treatment of pests—spraying and fumigating.

Viticulture.

General principles of grape culture for production of fruit, including—

Laying out vineyards, treatment of soil, cultivation, manuring, pruning, treatment of diseases and pests, picking crop, packing, and marketing.

There are no facilities at this vineyard for imparting instruction in wine-making.

Seeds.

Their identification, selection, and treatment before sowing, germinating power, effect of age, liability to disease, adulteration, quantity of seed for sowing, time and methods of sowing.

Experimental Plots.

Experiments with ordinary farm and new commercial crops, treatment and results, produce and cost, liability to disease, effects of various manures on different crops; lessons to be learned therefrom.

Sheep.

Characteristics, breeding, rearing, feeding, and general management of the chief breeds of sheep.

Special attention is paid to systems of topping-off sheep for export, and the use of a flock in rotation of crops.

Pigs.

Origin, points, characteristics, breeding, rearing, dentition, and general management of various breeds of pigs; killing and cutting up; bacon-curing; pig farming; pigs in connection with the dairy.

Construction of piggeries; drafting and loading yards. Common diseases of pigs, their treatment, prevention, and cure.

Poultry.

Origin, history, characteristics, breeding, rearing, feeding, fattening, and general management of the chief table and laying breeds of fowls, ducks, geese, turkeys, and capons.

Construction of fowl-houses, coops, &c.; incubators and their management; the sitting hen; storing eggs; marketing; exportation of poultry and eggs.

Ostrich Farming.

The origin, history, characteristics, and domestication of the ostrich. Breeding, feeding, treatment, and general management for the sake of its plumage. The plucking, care, and preparation of feathers for market.

Bees.

Origin, history, physiology, characteristics, and general management of bees.

The Dairy.

Its construction and temperature; utensils, appliances, machinery, and milking machines; their kinds, care, and preservation; selection of pastures for milk, butter, and cheese. Forage crops; conservation of fodder. Selection of animals; breeding, feeding, ensilage-making, milking, and general management.

Milk and its properties; influence of breed, food, and climate on quantity and quality of milk; milk testing and milk-testing machines, refrigerators; cream separators, management of cream, skimmed milk, aeration, cooling, Pasteurising, sterilising, and preserving; carriage and marketing.

Butter.—Treatment of cream, its Pasteurisation and ripening by lactic ferment; characteristics of good butter, and circumstances affecting it; its manufacture, churns, keeping qualities, colouring, preservatives, washing, salting, packing, marketing, export, cost and value.

Cheese.—Characteristics of good cheese, and circumstances affecting it; varieties of cheese, systems of manufacture, flavour, appearance, storing, ripening, packing, marketing, export and import, cost and value; rennet and its nature.

Excursions.

From time to time visits are paid to farms, orchards, shows, works, poultry farms, dairy and stud farms, stock sales, and cattle, in the neighbourhood, and reports thereon written by the students.

Practical work of the Farm.

Students engage in practical work of all kinds on the College farm, which occupies over 3,500 acres. They are instructed with regard to details; arrangement and construction of buildings, yards, and fences; construction, management, and working of implements and machines; cleaning, feeding, and general management of live stock; identification and selection of seeds; operations taking place on the farm in connection with various products; carpentering, blacksmithing, drainage and orchard work; operations with stock; judging of animals; naming of parts; explanation of good points; examination of various breeds; valuations, experiments, and results; prices current, and all things incidental to the working of a fully equipped farm.

Everything possible is done that can be likely to aid students in understanding the general principles of farm management and work, with practical acquaintance in the details of same, cultivation of crops, treatment of stock in health and disease, and the economical carrying on of farm work generally.

Examinations for Diploma.

Practical Work.

Students entering for the Diploma Examination for practical work upon the farm may be invited to perform either or all of the following work by the practical work examiner:—

1. Milking cows, making butter, use of dairy appliances, and general dairy work.
2. Killing and dressing sheep.
3. Carpentering work, such as mortising and cutting tenons, setting out roof, and general bench work.
4. Blacksmith's work, such as welding iron, making bolts, fitting and putting on horse-shoe.
5. Fencing, mortising posts, putting up wire or other fences.
6. Yoking up and driving bullocks.
7. Garden and orchard work—use of implements, handwork, grafting, budding, pruning, spraying, fumigating, laying out vineyards and orchards, handling crops, packing, canning, drying.
8. Horse work—ploughing, striking out and finishing, using mowing machine or reaper or binder, manure spreader, discs, horse-hoes, etc.
9. Haymaking—the principles of stack building and thatching.
10. Farm implements—the manipulation of any of the farm implements or machinery upon the farm.
11. Engine—driving the steam engine for either the sawing plant or any other machinery, explanation of the working parts, etc.; also electromotor.

Viva Voce Examination.

This examination in agriculture may comprise questions within the range of the following subjects:—

1. The soil and its preparation for various crops.
2. Cultivation, sowing and harvesting of various farm crops.
3. Fallowing land and green manuring.
4. Manures and manuring for various farm crops.
5. Mixed farming with sheep and rotation of crops.
6. Implements of the farm, their cost and uses.
7. Irrigation for various crops, methods of applying water, and quantities.
8. Land drainage—its importance, principles, cost, and effects.
9. Farm buildings, fencing, stock and sheep yards, drafting yards, swing gates, slip panels, etc.
10. Silos and silage—harvesting and methods, crops for sour and sweet silage.
11. The orchard, vineyard, vegetable garden, arboriculture, etc.
12. The dairy—milk, butter, and cheese; judging dairy stock; the management of pastures; conservation of fodder; rearing of calves.
13. Live stock of the farm—horses, cattle, sheep, pigs, poultry, and bees.
14. Business management of the farm, etc.; book-keeping, etc.

Veterinary Science and Practice.

1. Anatomy of the domestic animals, including organs of the body and their special functions.
2. Diseases most frequently met with in agricultural life other than special diseases.
3. Specific diseases, both those known in the State, and those which may sooner or later manifest themselves—*e.g.*, foot and mouth disease, cattle plague, etc.
4. Hereditary diseases, special reference to.
5. Conformation of the horse as pertaining to work and disease.
6. How to examine for unsoundness, inspection of meat.
7. Surgery—Operations and instruments; accidents and methods of treatment; horse-shoeing, its importance as to soundness.
8. Materia medica—their classification, methods of administration, nature and use of medicine and therapeutics.
9. Rudiments of Physiology.

The above relate to the horse, ox, sheep, pig, dog, and fowl. Occasional practical demonstrations and operations will be held.

First aid to sick or injured stock.

Special Dairy Course.

A course of six months scientific and practical instruction in dairying is available.

Farm Dairy Work.

The dairy herd breeding, rearing, selection, feeding, milking by hand and machines, housing, and general management.

Selection and preparation of sites for cow-sheds, dairies, and other farm buildings, and suitable equipment.

The

The growth of pasturage, cereals, and forage crops, conservation of fodder, ensilage, hay.

Milk, its composition and physical characteristics, treatment, aeration, and storage.

Testing milk, estimation of acidity, detection of adulteration, dairy bacteriology, with microscopic demonstrations and laboratory practice; the relation of bacteria to dairying; the fermentations of milk; the principles of Pasteurisation and sterilisation; the preparation and use of pure cultures, starters, or lactic ferments; the filtration of water for manufacturing purposes and its examination; preservation of milk and its products; ripening of cream with and without starters.

Butter-making.

Churning, working, salting, packing, and other operations associated with the manufacture of butter for local and foreign markets.

Cheese-making.

The treatment and ripening of milk, the estimation of acidity, renneting, cooking, dressing, pressing, curing, storing, and other details required in the manufacture of Cheddar cheese.

Machinery and Appliances.

The setting up, adjustment, and running of separators, replacement of worn parts, ordinary steam fitting and plumbing; the arrangement, size, and speed of shafting, belts, and pulleys; the care and management of engines, boilers, and refrigerating machinery—principles of construction.

Book-keeping.

To embrace the proper keeping of books and accounts for dairy-farms, creameries, butter-factories, payment by results, the formation of co-operative companies.

Veterinary Science.

Lectures will be given, with demonstrations, on the common ailments of and injuries to dairy stock; infective diseases, their diagnosis and treatment; castrating, spaying, and application of the tuberculin test; obstetrics.

Examinations for the special dairy certificate will be held the first week in January and the first week in July.

The practical examination will include dairy-farming, butter-making and cheese-making, and the theory examination will embrace a paper on each of these three subjects.

In order to secure a pass, students must obtain 50 per cent. of the maximum marks.

Agricultural Chemistry.

A course of lectures in Chemistry, with demonstrations in its relation to agriculture, will be given, and will extend over the full College course of two years.

They are designed to treat of those elements and compounds of importance to plant and animal life; of the chemistry of soil formation, treatment, and improvement; of the chemistry of manuring and feeding; and of the chemistry of crops.

Laboratory.

Practical tuition will be given in the Laboratory in Qualitative and Quantitative Analysis, when the student will examine the composition of soils, manures, and farm products.

Bacteriology.

A course of lectures, with laboratory practice and microscopic demonstrations, will deal with the classification of bacteria; their growth, life-history, and characteristics; their relation to agriculture, dairying, plant and animal diseases, and the industrial arts.

Agricultural Engineering.

(Physics.)

A course of lectures will be delivered to the second-year students in Agricultural Engineering, including the treatment of general physical phenomena, force, energy, work, simple machines, and building materials.

Agricultural Surveying.

A course of lectures will be delivered to the first-year students in Farm Surveying, treating of measurement of length, area, volume, and simple methods of land surveying, alignment, location, areas, levelling, and drainage.

Practical Work.—This will include actual surveys and plottings by the students.

All lectures are illustrated as much as possible by diagrams, specimens, appliances, and apparatus, and supplemented by actual work in the laboratories.

Agricultural Botany.

Students are made acquainted with the most useful native and introduced grasses and fodder plants, our weeds, poisonous plants, trees, and principal economic plants.

Examination and testing of seed is largely carried out. Careful study is made of the fungi of economic importance.

The chief points dealt with are as follow:—

Elementary Botany.—Anatomy of Plants: *The axis* and its appendages. *The root*, its structure, uses, duration. *The stem*, its structure, uses, habits, and modifications; herbs, shrubs, and trees, length of life, annuals, biennials, and perennials; epiphytes, parasites, and saprophytes. *The leaf*, its structure, uses, and modifications; bracts, buds, stipules, tendrils, phyllodes; stomata, transpiration, assimilation, respiration. *The flower*, calyx, corolla, their forms and uses; the chief kinds of inflorescence; colours, nectar; essential organs, stamens, and their structure, pollen; the pistil, ovary, and ovule. *Fruits:* germination, vitality, dispersion and selection of seeds.

Physiology

Physiology of Plants.—Minute structure, the vegetable cell and its contents, protoplasm, cell sap, chlorophyll; osmose and the circulation of fluids in plants; ingredients in the ash of plants. Plant food, what it is, how absorbed, elaborated, and utilised. Rotation of crops. Reserve materials. Resting periods. Reproduction, cross fertilisation, hybrids; movements; odours. Conditions necessary for healthy growth; variation and the influence of surroundings; selection, natural and human.

Every opportunity is taken to give students practical acquaintance with pruning, budding, grafting, spraying, and other operations in orchard and field (in addition to the regular outdoor work) by means of frequent class excursions.

Classification, &c.—Nomenclature, classes, orders, genera, species, varieties. Climate as affecting vegetation; forests. Our indigenous flora and its uses.

Economic Botany.—Consideration of the natural orders containing the chief economic plants.

Vegetable Pathology.

Diseases of cultivated plants, due to fungoid or mechanical causes; their nature and diagnosis; full details as to the best treatment for prevention or palliation.

Life history of the chief fungus types.
Bacteria as affecting plants.
Spraying machines.
Fungicides, how to prepare and apply them.

Agricultural Entomology.

This subject is studied, for the most part, in a specially built and equipped Entomological Laboratory and Insectary, where a complete collection of insect pests, etc., is maintained fresh and mounted for educational purposes. The work covers instruction in anatomy, physiology, metamorphosis, habits, classification, and geographical distribution; use of the microscope; examination and determination of specimens. Particular attention is paid to insects and other animals injurious to vegetation; to their natural enemies and parasites; and to the best methods of avoiding or restricting their ravages.

Museum and working collections are formed in order to provide material and familiarise students with the local insects of economic importance.

Students require a pocket magnifying glass (cost, 3s. 6d.); a quarto exercise-book of at least 200 pages.

Arboriculture.

Importance of the subject and its special application to New South Wales, objects of tree-planting shelter, regulation of temperature and rainfall, ornament and profit; preparation of land, selection of trees, care when young, planting, after management, adaptability of soils and climate to rapid results; indigenous and exotic trees, ringbarking and clearing, cost and effects.

Meteorology.

Apparatus and methods; temperature of air and soil; atmospheric moisture and precipitations; evaporation; winds; storms; cloud and sunshine; application to agriculture; plant phenology; effects of temperature and rainfall on plants; weather signs and forecasts; climate of New South Wales; droughts.

Climate—Special tuition is given in farm meteorology, and students are instructed in the use of all the observation instruments.

Farm Book-keeping (Double Entry).

Third and Fourth Sessions.

Methods adopted for farm, station, orchard, dairy, or other special farming operation.
Description of the various books required.
Day-book, journal, ledger, and subsidiary books.
Capital; assets and liabilities.
Opening and closing the ledger.
Various kinds of accounts—personal, nominal, real, or property.
Profit and loss.
Trial balance, balance-sheet.
Taking stock, valuation and depreciation.
Monetary transactions; cash, cheques, bank-notes, bills, promissory notes. Banking; interest, discount; licenses, commission, stamps, credit.
Partnerships—insolvencies and bad debts.
Course of exercises in double entry.
Exercise-books will be provided at the College.

English and Arithmetic.

First and Second Session.

Business letter-writing, essay work and composition, occasional lectures on business habits, trade statistics, farm law.

Arithmetic.—Barnard Smith.

Examination.

The annual examinations are held in December and occupy two weeks. The written examinations are held the first week. Samples of questions appear in the following pages.

The practical examinations are conducted on the Farm and are controlled by four outside examiners appointed by the Minister of Agriculture. Students have to show absolute proficiency in driving, riding, and harnessing horses, mules, and bullocks.

Ploughing

Ploughing, harrowing, rolling, cultivating, drilling, broadcasting, reaping and binding by hand and by machine, harvesting, mowing, fencing, scrubbing, ringbarking, cutting chaff, threshing, winnowing, horse-shoeing, rough carpentry, rough blacksmithing.

Breeding, feeding, and management of sheep, goats, horses, cattle, pigs, and poultry.

Veterinary first-aids to sick and injured, including cutting colts, bulls, pigs, and rams, marking lambs; shearing and management of wool, also sorting. Each student must make his own cheese, butter, jam, bacon, dry and bottle fruit.

Must practically control and run a steam boiler, engine, oil engine, and electric motor.

Orchard work, such as ploughing, scuffling, cultivating, planting, pruning, spraying, grafting, packing, drying, etc., etc.

Poultry Examination Paper.

The Written Poultry Examination, held at the Hawkesbury Agricultural College, July 23rd, 1904, for the College Poultry Certificate.

Questions.

1. Describe the origin of our domestic fowl and trace from the original wild varieties down through natural and artificial selection. Full marks awarded, 10.
2. Which of the original breeds were considered the best for eggs and which for table use? Full marks awarded, 5.
3. Have these propensities been amalgamated in other breeds? Full marks awarded, 10.
4. Describe what you know of the College egg-laying competitions and the benefits derived from them. Full marks awarded, 15.
5. Give routine of the daily work on a poultry-farm. Full marks awarded, 15.
6. Describe the process of incubation and brooding. Full marks awarded, 15.
7. Name the most common diseases met with in the poultry-yard and give a remedy for each. Full marks awarded, 15.
8. Give a general description of poultry other than fowls. Full marks awarded, 15.

Orchard Examination, 17th December, 1901.

Time allowed—Three hours.

1. What precautions would you take in selecting a site for an orchard for the purpose of raising peaches, apricots, and raisins? State what district you would prefer, and how you would prepare the soil. Provided it was necessary to drain, what system would you adopt?
2. Give the distances apart at which you would plant the various kinds of fruit-trees and vines, and explain the system of planting you would adopt.
3. Describe fully the pruning of the peach, the pear, and the fig, from the time of planting until four years old.
4. At what age would you prefer to buy your summer and citrus fruit-trees for planting?
5. What is the object of summer-pruning fruit-trees and vines? State what kinds require most pruning and what the least.
6. State what you know about the application of manures to fruit-trees and vines. Given a poor sandy soil, such as that at the College, what fertiliser or fertilisers would you apply to stone fruits and what quantity would you use per acre?
7. Name five varieties of each of the summer fruits suitable for drying, also a few of the best grapes for drying.
8. Describe the system of sun-drying peaches, apricots, prunes, apples, raisins, and sultanas.
9. Name some of the most destructive pests affecting citrus fruits, and describe the fumigation process.

Dairy Examination, Hawkesbury Agricultural College, July, 1903.

Cheese-making.

Time allowed—Three and a half hours.

If we divide Cheddar cheese-making into four sections as follows:—

1. From the drawing of the milk from the cow;
2. From cutting of curd to removal of whey;
3. From removal of whey to vatting;
4. From vatting to placing the ripened cheese on the market;

Please state the chief points in connection with each section—how the processes are best performed; what mistakes beginners are most likely to make, and how to avoid such errors. These serve as the first four questions.

5. What causes gas in milk and in the subsequent curd? How would you treat a gassy batch, and how is gas best avoided?
6. What are the peculiarities and defects of a very slow and of a very fast coagulation?
7. In what way do bacteria affect the cheese-maker?

Dairy-farming.

Time allowed—Three hours.

1. State what you know about the two crops—maize and lucerne, both as regards their cultivation and feeding value.
2. Contrast the Ayrshire and Holstein breeds of cattle for general dairy-farming purposes. Give the characteristics of each.
3. Suppose the cows are being housed in winter and the milk is being sold for butter-making, what foods would you use? Give a sample of a full daily ration for a dairy cow in full milk, and weighing about 1,500 lb. live weight.

4. If you were a dairy-farmer who supplied cream to a factory as follows:—

In January	8,630 lb., testing	33	per cent. fat.
February	7,945 „	42	„
March	6,842 „	53	„

How much butter should you be paid for each month, and how much money should you get for the quarter's supply, if paid at the rate of $9\frac{1}{2}$d. per lb.?
5. How should heifer calves of the Shorthorn breed be treated from birth till 2 years old if intended for dairying?
6. What causes tuberculosis in cattle? How might the disease be detected or diagnosed? What would be the effect of a tuberculous bull, and what of tuberculous cows on the calves of such animals?
7. Discuss in a brief and general manner the breeding and feeding of pigs by the dairy-farmer for fattening purposes.

Dairy Examination.

Butter-making.

Time allowed—Two and a half hours.

1. What is the composition of cow's milk, and what purpose and place, if any, has each constituent in butter-making?
2. What role do bacteria play in dairying from a buttermaker's point of view?
3. Describe the process and principle of refrigeration by ammonia machines?
4. Explain the basis of the Babcock test, and state clearly why a greater percentage of "overrun" should be allowed in case of a 50 per cent. cream when compared with a 30 per cent. cream?
   By "overrun" is meant the difference between butter fat and commercial butter, when estimating the butter yield and comparing the Babcock results with the actual churn result.
5. Seven creams, of ages varying from three hours to seven days old, are mixed together, and churned immediately. State your views of such a mode of procedure, giving the reasons for such views?
6. Why should butter be washed? Why should not butter be churned into lumps the size of marbles?
7. Describe the part which temperature plays, or may play, in butter-making?

Butter-making and Creamery Managers' Examination.

Time allowed—Three hours.

1. Give a definition of, and state the uses of, the following:—Thermometer, lactometer, cyclometer, hydrometer. Convert 60 degrees Fahrenheit into the corresponding degree Centigrade.
2. Give a definition of the following terms, and explain the principles which underlie these processes:—Fermentation, Pasteurisation, sterilisation?
3. What is the difference between lactic and butyric fermentation, and how does each affect the butter-maker? How might each be checked or prevented?
4. What is the difference between sweet and sour cream, from every point of view? At what stage may cream be said to be over-ripe, and what is the harm of allowing cream to be over-ripe?
5. Given three cream suppliers—

No. 1 supplies	35 gallons of cream, testing	28	per cent. butter fat.	
No. 2 „	105 „ „	36	„	„
No. 3 „	80 „ „	33	„	„

   How much butter should be paid for?
6. What is the average composition of milk, separated milk, buttermilk, and butter? Mention some of the things that affect the composition of milk and of butter.
7. Describe the part which temperature plays in dairy work, from the time the cow is milked until the butter is made and consumed?
8. State what part the following constituents take in butter, and give your opinion how these items may be controlled: Water, casein, albumen, milk, sugar, and salt?
9. Given 8,000 gallons of milk received for the week in a separating station, from the following suppliers, in the following proportions:—

Geo. Smith	3,100 gallons,	testing	3·4
S. Jones	900 „	„	3·1
T. Johnson	2,400 „	„	3·2
J. Thompson	1,600 „	„	2·6

   Suppose the cream is supplied to a central factory, and that 3,000 lb. of butter is made from the whole lot, how much butter should go to each supplier's account, and what amount of money net should each receive, suppose butter to fetch 10d. per lb. and that the cost of manufacture is $1\frac{1}{2}$d. per lb.

Examination on Pigs and Pig-breeding for Special Piggery Course Students, 21st November, 1903.

Time allowed—Three hours.

1. What are the leading points to note in selecting a boar of any breed?
2. Briefly describe the Berkshire and large white Yorkshire pigs.
3. What breeds of pigs are most suitable for the pork trade? State the age and weights.
4. How should a sow be treated immediately before farrowing, and what are the indications of farrowing?
5. Define the terms—Carbo-hydrate, in-breeding, prolificacy, and gestation.
6. State the normal temperature of a pig, the beats of the pulse per minute, and the period of gestation?
7. Give a list of grasses, roots, cereals, and other crops available for pig-feeding on a farm in the Hawkesbury District during midwinter and spring.
8. In what way is the grazing of lucerne beneficial in pig-raising.
9. How are pigs affected when suffering from—
   1. Tuberculosis. 2. Swine fever.
10. What precautions would you adopt in the event of an outbreak of swine fever?
11. Relate the causes of constipation and state what steps you would take to relieve it in a pig.
12. Describe the process of smoking bacon, and state the action of smoke on the flesh.

Book-keeping.

Book-keeping.—Diploma Students.

Time allowed—Three hours and a half. Marks—100.

Journalise and post into the Ledger the following transactions; draw up Trial Balance, Profit and Loss Account, and final Balance Sheet:—

On the 31st December, 1901, A. Sweeney found the state of his affairs to be as follows:—

	£	s.	d.	£	s.	d.
Overdrawn at Bank of N.S.W.	....			350	0	0
Bills payable—No. 46, due 16 Jan.	100	0	0			
" " No. 47, due 4 Feb.	75	10	0			
				175	10	0
Amount owing to Peter Burrows	45	0	0			
" " E. Taylor	27	12	6			
				72	12	6
Cash in hand	....			27	10	0
Stock at valuation	500	0	0			
Crops "	230	0	0			
Dairy produce...	17	10	0			
				747	10	0
Plant and machinery	....			350	0	0
Amount owing by S. Plummer	133	0	0			
" " H. Wigzell	25	0	0			
				158	0	0

On the 1st January, 1902, A. Sweeney agrees to take into partnership Frank Saywell, with a capital of £1,000, on the understanding that he accepts the above liabilities and assets, and that the profits and losses are to be equally divided.

All cheques to be deposited with Bank on the day of receipt, and all payments over £5 are made by cheque.

1902.		£	s.	d.	£	s.	d.
January 2	—Paid into Bank F. Saywell's capital	....			1,000	0	0
" 4	—Received from S. Plummer cheque for	....			129	13	6
	Discount allowed	....			3	6	6
" 5	—Sold to F. Wimble—						
	50 sheep @ 17/6	43	15	0			
	50 bushels barley @ 5/-	12	10	0			
					56	5	0
" 6	—Sales from dairy	....			6	6	0
" 6	—Paid wages	....			9	7	6
" 8	—Sold to S. Kent for bill at 2 mos.—						
	100 bushels oats @ 3/-	15	0	0			
	3 tons chaff @ £5	15	0	0			
					30	0	0
" 9	—S. Plummer's cheque returned by Bank, dishonoured.						
" 11	—A. Sweeney drew cheque	....			20	0	0
" 12	—Sold at auction, stock, and received cheque, less 5% commission	....			120	0	0
" 13	—Paid wages	....			9	9	0
	Cash sales—Butter, etc.	....			7	12	6
" 15	—Sold W. B. Lawson—						
	Stock	75	0	0			
	Crops	33	0	0			
					108	0	0
" 16	—Bill payable due this day, honoured.						
" 18	—Paid P. Burrows by cheque, less 5% discount.						
" 20	—Paid wages	....			10	0	0
	Dairy sales	....			4	4	0
" 22	—Sold for Cash—Crops	10	10	0			
	Stock	13	10	0			
					24	0	0
" 24	—F. Saywell drew from Bank	....			20	0	0
" 25	—Paid for repairs to machinery	....			4	17	6
" 26	—Sold to R. Campbell—Stock	....			30	0	0
" 27	—Paid wages	....			10	10	0
" 27	—Cash sales, butter, etc.	....			3	17	6
" 29	—Accepted composition of 13/4 in the £ from H. Wigzell.						
" 30	—Consigned to W. Smith & Co. of Newcastle, to sell on our account and risk, stock valued at	....			120	0	0
	Paid shipping charges, etc.	....			20	0	0
" 31	—Write off 10% depreciation on plant and machinery.						

Valuations:—	£	s.	d.
Stock	250	0	0
Crops	200	0	0
Dairy	10	0	0

AGRICULTURE.—DIPLOMA STUDENTS, DECEMBER, 1902.

Time allowed—Three hours and a half.

Introduction.—Answer each question in the order given. Begin an answer on a fresh sheet, and each section of an answer as a fresh paragraph.

Marks.

10 1. How have the agencies of Nature acted in the formation of soils? And give the percentages of sand, clay, and organic matter in some of the soils to be met with in this State.

10 2. What breeds do you prefer for stocking a dairy-farm supplying a creamery? And give reasons.

10 3. What is the cost of the upkeep of a team of two farm horses per annum (food, shoeing, and depreciation of value); and mention the acreage of tillage land such a team would be considered capable of working per annum.

10 4. There are particular dangers to be guarded against in harvesting grain-fodder crops in a season of many showers and succulent growth: Name them, and describe how to harvest a rank crop of oaten hay in such a season.

10 5. Outline a course of mixed farming for s square mile of good land in the highlands or central area, next the eastern seaboard of this State. Note character of soil, average rainfall, areas of crops, and number of head of live-stock that could be carried during the year.

10 6. Briefly describe one or more fly pests that attack the horse, ox, and sheep in this State, and suggest methods of prevention.

10 7. Give an outline of the necessary requirements for conducting a dairy-farm of 320 acres in any one of the coastal districts of New South Wales,—the land to be, say, one-third rich, and one-third moderate pasture, and the rest bush and upland. Give numbers of live-stock, enumerate the rolling-stock, and state the capital required, excluding the cost of purchasing the land.

10 8. Name the fairly useful grasses of medium quality, indigenous as well as introduced, also those recommended as the best for pasturage.

10 9. Name the various breeds of horses, cattle, sheep, and swine met with in New South Wales.

10 10. Describe the cultivation of any one of the following, noting the tilth, cultivation and harvesting; also the varieties preferred for growth:—10 acres of cabbage or of field peas; 12 acres of orchard of any variety of fruit; a 30-acre vineyard; 10 acres of rye-grass for pasture and seed; an area of lucerne laid down for ten years.

Maximum 100

CHEMISTRY—THEORETICAL.—DIPLOMA EXAMINATION, DECEMBER, 1902.

1. Mention the nitrogenous constituents of the atmosphere, and tell what you know of their sources.
2. Explain why soils may differ in temperature, though under equal conditions of exposure.
3. Under what conditions can the nitrogen of the air become fixed in the soil?
4. Discuss the relative merits of lime and carbonate of lime when applied to the soil.
5. Why are manures required?
6. Describe the chemical effects of drainage.
7. Explain the difference in composition and value of bone ash and superphosphate.
8. Calculate the value per ton of sulphate of ammonia, 96 per cent. purity, at 12s. 6d. per unit nitrogen.
9. Explain the benefits arising from the application of gypsum (calcium sulphate) to the soil.
10. A certain food contains $11\frac{1}{2}$ per cent. albumenoids, 6 per cent. fat, and $56\frac{1}{2}$ per cent. carbohydrates: Calculate its albumenoid ratio, and state for what class of animals it would be suitable.

PRINCIPLES OF AGRICULTURE.—DIPLOMA STUDENTS, DECEMBER, 1903.

Time allowed—Three hours.

Marks.

10 1. Give the percentages of the three principal elements of plant-food in a properly-proportioned mixed fertiliser for (1) cereals; (2) potatoes; (3) pasture.

10 2. In a wet season like the present, what method would you pursue for the conservation of fodder? and describe it.

10 3. Give a practical and detailed account of the culture and harvesting of a wheat crop, from the seed-bed to delivery of grain to the purchaser, noting yield per acre, total cost per acre, and profit per acre, at 3s. 3d. per bushel.

10 4. Briefly describe drill husbandry, name of its inventor, date of introduction into English agriculture, crops suited for it, and reasons for its superiority over more crude methods of tillage.

10 5. What do you understand by intense culture? and illustrate it.

10 6. What is meant by mixed farming? and state the position it might, with advantage, occupy in New South Wales agriculture.

10 7. Mention what crops are suited for green manuring, and give reasons why it is beneficial to the soil.

10 8. Name the various parts of a typical iron single-furrow two-wheeled plough, and briefly describe the varieties of ploughs known in Australian agriculture, with reasons for such variation of design.

10 9. What is meant by 100 points of rainfall? and give the weight of water in tons when an inch of rain falls on an acre; also the number of gallons, and of cubic feet for the same quantity. How many inches of water does 1 acre of a 5-bag crop of wheat exhale during its growth from sowing to harvest?

10 10. A poultry-farmer, running 1,500 laying hens, has need to keep up his stock with young birds: About how many eggs would he be required to incubate to give him the requisite number of pullets, and what would be the probable money return per annum, from sale of eggs at 10d. per dozen; of surplus cockerels, at 4s. 6d. per pair; and of old hens at 2s. each? [Allowance must be made for infertility of eggs during incubation and losses during the rearing of the chickens.]

Maximum 100

Applied Mechanics.

Not more than six questions are to be attempted.
All questions are of the same value.
Candidates are strongly advised to answer precisely the questions that are set, and nothing more. No credit will be given for supplying general information that does not bear directly on the question in hand.

Time allowed—Three hours.

Marks.

10 1. State clearly the theorems known as the triangle of forces and the polygon of forces.
A picture, weighing 56 lb., is slung over a nail in the ordinary way by a cord attached to two eyes in the top horizontal bar of its frame. If the height of the nail above this bar is half the distance between the eyes, what is the tension in the cord?

10 2. Make neat sketches of a simple crane, and show how you would determine the stress in each part of it when a load of 10 cwt. is being lifted.

10 3. What is meant by the terms—density and specific gravity? Describe some methods for determining the specific gravities of solids and of liquids.

10 4. How would you prove the truth of Boyle's Law? Explain clearly the principle of the mercurial barometer and of the siphon.

10 5. Define the terms—work, horse-power, energy. A cable 700 feet long (and weighing 15 lb. per foot) hangs vertically down a shaft having a metal ball (weight 250 lb.) attached to its lower end. If 450 feet of the cable are wound-in in four minutes (thus leaving 250 feet still hanging in the shaft), at what rate in horse-power is the work done?

10 6. Make neat and accurate sketches of a force pump or a hydraulic ram.
A hydraulic crane is supplied with water at a pressure 700 pounds per square inch, and uses 2 cubic feet of water in order to lift 4 tons through a height of 12 feet: How much energy has been supplied to the crane, and how much has been converted into useful work?

10 7. Write a short essay on the characteristic properties of cast-iron, wrought-iron, and steel. Give figures showing the tensile and compressive strengths of each.

10 8 Write a short essay on Australian Timbers, giving an account of the strengths and properties of the more important ones, and of the various purposes for which they may be most suitably used.

Sheep and Wool.—December, 1902.

Time allowed—Two hours and a half.

1. How many years old is a six-tooth sheep?
2. What is a Comeback sheep?
3. Give six distinct breeds of sheep.
4. What sort of country is most suitable to the Lincoln, Leicester, and Shropshire?
5. What are the main points in connection with Romney Marsh sheep?
6. What sheep grows the coarsest wool, and describe the wool briefly?
7. What is the best breed for mutton purposes?
8. What are serrations?
9. What is yolk?
10. What are the chief points in a combing wool?
11. What the chief points in a clothing wool?
12. What is meant by counts or spinning qualities of wool?
13. What are noils?
14. What is a fair average period of gestation for a merino ewe?
15. What is the difference between a wool-classer and a wool-sorter?
16. What are the four principal classes into which fleece wool is classed?—and describe each class briefly.
17. What is the difference between hair and wool?

Veterinary Science.—December, 1902.

Twelve questions to be answered. Time allowed—Three hours.

1. Describe the situation of the heart, liver, and kidneys.
2. Give the symptoms and treatment for colic.
3. Give the symptoms of choking in an ox, and how to relieve it.
4. Describe pleuro-pneumonia, and how to arrest its course.
5. What are the distinguishing lesions of anthrax?
6. Give the symptoms of tick fever.
7. Where are tubercles most frequently found in cattle?
8. Describe strangles in horses, and the treatment.
9. Name four diseases in horses' feet causing chronic lameness.
10. Give the situation on the suspensory ligament, and treatment for sprain.
11. How would you treat a fractured tibia.
12. Describe castration in the horse, ox, sheep, and pig.
13. Give the treatment for milk fever in cows.
14. Give the treatment for broken knee.
15. Describe mammitis, its effects and treatment.
16. Describe symptoms and *post-mortem* lesions diagnostic of swine fever.

Agriculture.

AGRICULTURE.—FIRST YEAR STUDENTS.—DECEMBER, 1902.

Time allowed—Three hours.

1. Describe the action of lime on soil.
2. Name the principal cereal, forage, and root crops suitable to this district.
3. Describe green manuring—its objects, and the best crops to utilise for the purpose.
4. Explain the advantages of drainage—natural and artificial; and state the classes of land for which drainage is necessary.
5. Relate all the operations in order required to grow and harvest a crop of Algerian oats on virgin land.
6. Explain the uses of the harrow, scarifier, and roller.
7. Quote the advantages to be gained by the application of farm-yard manure; and the best methods for its collection and treatment.
8. Name the samples of seeds submitted; give also the time of sowing each variety, and the amount of seed required per acre.
9. Mention any features of value which the millets, as a class, possess. What special merit have they during the present season?
10. What methods would you adopt to improve an area of poor soil? Give reasons for the practice you recommend.
11. Describe the cultivation of the Swede turnips for market.
12. Give fully the procedure you would select to raise and harvest a crop of maize for grain.

ENGLISH AND ARITHMETIC—JUNIORS.—DECEMBER, 1903.

Time allowed—Three hours.

Marks. You are only to attempt nine questions, which must include the first five.

10 1. Write a description of a spade, and explain the work it does.

10 2. Explain the "rule of the road" in walking and driving.

12 3. Define—Suckering, payee, affirmation, indigenous, defoliate, property.

18 4. Write an essay, limited to sixty lines, on (*a*) Books, or (*b*) Goats.

10 5. What would it cost to spray 13 acres of apples, growing 22 feet apart each way (square system), with Bordeaux mixture, using $\frac{3}{4}$ of a gallon per tree? Formula:—6 lb. copper sulphate, 4 lb. lime, 40 gallons water. Costs:—Copper sulphate, 22s. 6d. per cwt.; lime, £1 per ton; water, 1s. 6d. per 1,000 gallons. Take labour at double the cost of material and allow 1s. per 100 trees for outlay on machinery.

10 6. It is desired to spread three different manures on three separate acres of land, at a cost of 25s. per acre in each case: Find the respective weights of manure—No. 1 costing £4 10s. per ton; No. 2, £5 12s. 6d.; No. 3, £6 15s.

10 7. Calculate the cost of ploughing at 3s. 6d. an acre, a paddock measuring 93 chains x 147 chains.

10 8. Provide an approximate cost per mile for the College boundary fence (post, top rail, and 6 wires).

10 9. Find the square root of 123456789 to 5 places of decimals.

10 10. Find the number of vines required to plant 7 acres of land, if put in 6 feet x 10 feet, and their cost at £1 17s. 6d. per 1,000.

10 11. Find the weight of water that fell on an acre during September, the rainfall being 4·622 inches (answer in tons, cwt., qrs., lb.).

BOTANY AND VEGETABLE PATHOLOGY—FIRST YEAR.—DECEMBER, 1903.

Time allowed—Two and a half hours.

Five questions only may be answered. The value of each question is the same. Credit will be given for drawings illustrating a reply.

Marks.

20 1. Give a list of the weeds you have observed on the College grounds this year, and tell me anything of interest concerning them. Have any been observed for the first time, and how do you think they got there?

20 2. Tell me what you know about the fungus diseases which assail the wheat plant, and the remedial measures you would adopt.

20 3. You want to cut down some trees in a certain paddock, and you wish to avoid suckering: What precautions would you take to minimise the risk? and give reasons for your precautions.

20 4. What is the essential difference between a root and a stem? Name various kinds of roots. What are root-hairs? Many plants on Mount Kosciusko and in the Western interior have very large roots: Why is this?

20 5. Describe carefully a typical grass. Give a list of the introduced grasses seen by you growing in the College grounds during 1903, giving brief notes about each.

20 6. What is the difference between a gum and a wattle? Select any district in the State and tell me what you know about six of its eucalyptus trees and of the timbers of the same.

Marks.

20 7. What trees produce the best wattle-bark? When would you strip it, how would you strip it, and what would you do from the stripping to the placing on the market of the finished article? What part of the tree gives the most valuable bark?

20 8. Describe a plant-cell. What is reserve material? What is a stoma? What is transpiration? Explain venation, filament, calyx, pollen, ovule, wind-fertilisation, ligule.

Chemistry—Practical. First Year. Dec., 1903.

Marks. Time allowed—Four hours.

25 Make a qualitative analysis of—

each. 1. Two simple salts.

50 2. One mixture.

Full details of the work to be handed in.

Surveying—Mensuration. Dec., 1903.

Marks. Five questions to be answered. Time allowed—Three hours and a half.

6 1. Give reasons why a farmer should possess a rough knowledge of surveying.

9 2. Compile field notes of the survey of a farm having three regular sides and a frontage to a creek. Prismatic compass and a chain to be used.

9 3. Make a plot of the above survey to a scale of 10 chains to an inch (or another convenient scale), and calculate the area.

10 4. A farm is square, and 100 acres in area, and the owner wishes to subdivide it into the following various sections:—Grazing, 60 acres; cultivation, 20 acres; orchard, 5 acres; horse paddock, 10 acres; pigs, 2 acres; calves, 2 acres; house site, 1 acre. Draw a design for subdivision, and give length of all divisional lines, and the total length of fencing necessary to enclose each section, in rods.

8 5. The catchment area for a dam is 10 acres: Supposing a fall of 2 inches of rain on that area,—how many gallons of water would gravitate to the dam, allowing for a loss of 60 per cent. owing to soakage and evaporation.

8 6. A circular log is 21 feet long, 3 feet in diameter at one end and 4 feet at the other: How many posts 7 feet long x 4 inches x 8 inches, could be split from it, allowing one quarter as waste?

Levelling.

10 7. Compile field notes of a section of levels, showing at least twelve readings of the staff. Work out the reduced levels, and plot out the section, giving grade between starting and terminal points of section.

Viva Voce 40

Maximum 100

Chemistry—Theoretical. First Year. Dec., 1902.

Nine questions only to be attempted, which must include the first.

1. Define:—Chemical compound, atomic weight, valency, di-basic acid, salt, base, element, molecule, chemical equation, oxidation.
2. Describe how the composition of water may be determined by weight.
3. Explain fully the meaning of—

$$2\,NaCl + 2H_2SO_4 + MnO_2 = Na_2SO_4 + MnSO_4 + 2\,H_2O + Cl_2.$$
$$K\,ClO_3 = K\,Cl + 3O.$$
$$Zn + H_2SO_4 = ZnSO_4 + H_2.$$
$$NaNO_3 + K\,Cl = K\,NO_3 + NaCl.$$

4. Write the formulæ and give the properties and uses of—quicklime, ammonium sulphate, bluestone, copperas, potassium cyanide.
5. State the three laws of chemical combination.
6. Write a short account of the potash compounds used in agriculture.
7. Explain the construction of a saltpetre bed, and give the reactions that take place in obtaining saltpetre. Has this any bearing on agriculture, and how?
8. Give a short account of the composition of atmosphere.
9. Explain the cause of temporary and permanent hardness in water, and give methods for correcting these effects.
10. Write a description of the Ammonia Process for preparing sodium carbonate. Give equations.
11. It is required to apply 21 lb. of N. to the soil: How much ammonium sulphate would be required, and how much sodium nitrate? At. Wt. H = 1, N = 14, O = 16, S = 32, Na = 23.
12. Give an account of the four calcium phosphates—their occurrence, manufacture, properties, and uses.

Other

Other State Agricultural Institutions.

In addition to the means of agricultural instruction afforded by the comprehensive and scientific curriculum of the Hawkesbury Agricultural College, practical teaching is also available at the Government Experimental Farms at Wagga, Bathurst, Wollongbar, and Berry.

Wagga.

The Wagga Experimental Farm, which now covers an area of 3,500 acres, is situated at Bomen, on the Southern Railway, about 6 miles from the town of Wagga, and was opened in 1893, since which year about 110 students have passed through the Institution. There is accommodation for 22 students, and this is fully taxed. The terms are £25 per annum, payable half-yearly in advance. For special courses £2 2s. per quarter for non-residents, and 10s. per week for residents. During the last financial year 36 students attended, and most satisfactory report is made of their progress and conduct. This number includes many who took special courses in various branches for short terms. In addition to practical demonstration of the most economic and effective methods of producing and harvesting the usual farm crops suitable to the district, special experiments are made with fertilisers; and other experiments are also carried out under the direction of the Chemist and the Bacteriologist of the Department. Special experiments with new wheats, with the object of improving their milling qualities and testing their resistance to drought and rust, are also made. Another prominent feature is the attention given to the production, drying, and canning of fruits; and dried fruits, olive oil, &c., raised here bring high prices on account of their excellent quality. Recently the introduction of pure Shropshire, sheep and crossbred Merinos has created considerable interest. The area under cultivation is about 1,300 acres, of which 1,200 acres are mixed farming crops, and 100 acres for fruit-culture, the balance of the farm area being used for grazing purposes.

The main objects of this Farm are to demonstrate the most economic and effective systems of producing and harvesting crops; to carry out experiments to determine the suitability, or otherwise, of crops, not only for the Riverina district, but for other districts having similar climate and soils; the production of seed-wheat of the highest quality true to name; the improvement of wheats and other cereals; and the carrying out of exact scientific experiments.

An extensive area has been set apart for orchard, vineyard, and vegetables, where experiments are being carried out in all branches of horticulture adapted to the district. An important feature in connection with this branch of the Farm is fruit-drying and preserving, raisin-making, olive-curing, and the making of olive oil.

Another important branch is the breeding and rearing of stock of various kinds, growth and conservation of fodder crops, management of pastures, the production of milk for butter and cheese, the raising of sheep for mutton.

A limited number of students will be instructed in the principles of agriculture and horticulture, as applied to all kinds of work carried out on the Farm; in field operations; the use of farm implements and machinery; the necessary carpentering and engineering required on a large farm; the management of stock, poultry, bees; viticulture, fruit-drying, raisin-making, and various branches of gardening and orchard work.

Students will also be admitted for special instruction in the following branches:—Fruit preserving and drying, pruning, general orchard-work, poultry, sowing and harvesting of cereals, wool-classing and management of sheep.

Syllabus—Wagga Wagga and Bathurst.

Farm Section.

General principles of agriculture—

- The soil and methods of cultivation for various crops; ploughing, subsoiling, and drainage.
- The use of implements of all kinds in the treatment of soil, harvesting of crops, and preparation of produce for market.
- The management of horses, cattle, sheep, pigs, and poultry.
- The use of manures of all kinds for various classes of soil and crops.
- The conservation of fodder; hay-making, stacking, and thatching; ensilage by means of stacks, overhead and pit silos; storage of root crops; storage of grain and treatment for weevil and pests.
- Elementary carpentry and blacksmith's work; erection of farm buildings and commonplace repairs to buildings, fences, implements, harness, &c.

Orchard Section.

General principles of fruit culture, including—

- Selection of soil; preparation and cultivation of soil for various classes of fruit-trees; cultivation; manuring; pruning; harvesting; packing; preservation of fruits by drying, canning, pulping, jam-making, &c.; treatment of pests—spraying and fumigating.

General principles of grape culture for production of fruit for table and preserving—

- Laying out vineyards, treatment of soil, cultivation, manuring, pruning, treatment of diseases and pests, picking crop, packing and marketing, drying and preparation of raisins, sultanas, and currants.

In the orchard section at Wagga Wagga, students are enabled to take part in all the operations of working a plantation of nearly 100 acres of mixed fruit-trees and vines, and the disposal of the produce.

Examinations for Certificate.—Practical Work.

Students entering for the Farm Certificate for practical work upon the Farm may be invited to perform either or all of the following work by the practical work examiner:—

1. Milking and management of cows, and general dairy work.
2. Killing and dressing a sheep.
3. Carpentering work, such as mortising and cutting tenons, setting out roof, and general bench-work.

4. Blacksmith's work, such as welding iron, making repairs, fitting and putting on horseshoes.
5. Fencing, mortising posts, putting up wire or other fences.
6. General orchard work—use of implements, pruning, grafting, budding, treatment for pests, laying out land for planting vineyard or orchard.
7. General farm-work—ploughing, striking out and finishing, sowing, using mowing machine or reaper or binder, discs, horse-hoes, management of farm teams.
8. Hay-making—stack building and thatching.
9. Engine—driving the steam-engine for either the sawing-plant or any other machinery, care of boilers, cleaning and fitting of the working parts.
10. Management of sheep as a small farm flock.

Viva Voce Examination.

This examination in agriculture may comprise questions within the range of the following subjects:—

1. The soil and its preparation for various crops.
2. Cultivation, sowing, and harvesting of various farm crops.
3. Fallowing land and green manuring.
4. Manures and manuring for various farm crops.
5. Implements of the farm, their uses.
6. Irrigation for various crops.
7. Land drainage—principles, cost, and effects.
8. Farm buildings, fencing, stock and sheep yards, drafting-yards, swing-gates, slip-panels, &c.
9. Conservation of fodder by means of hay, ensilage, and storage; crops to grow for summer and winter fodder; management of pasturage; conservation of edible scrubs, saltbush, &c.
10. The orchard, vineyard, vegetable garden.
11. The dairy—milking, feeding, and care of dairy cattle.
12. Live stock of the farm—horses, cattle, sheep, pigs, poultry, and bees.
13. Business management of the Farm, book-keeping.

Bathurst.

The Experimental Farm at Bathurst is smaller than that of Wagga, comprising an area of 700 acres, of which about 340 acres are cultivated. The general operations are similar to the work carried on at Wagga, with a difference in respect to climate, soil, and other circumstances. Experiments in various kinds of wheat and the cultivation of the apple are features of the management. There is an irrigation plant in full work, and market-gardening is successfully carried on, while sheep breeding and fattening is one of the main purposes of the farm. Up to date 50 students have passed through this Institution, which was first opened in September, 1895. There is accommodation for 12 resident students, and there are usually about half a dozen non-residents in attendance. As is the case at Wagga, there are always candidates awaiting admission. The fees charged are the same as at Wagga.

The main objects of this Farm are to demonstrate the most economic and effective systems of producing and harvesting crops; to carry out experiments to determine the suitability, or otherwise, of crops, not only for the mid-table-land district, but for other districts having similar climate and soils; the production of seed-wheat of the highest quality true to name; the improvement of wheats and other cereals; and the carrying out of exact scientific experiments.

An extensive area has been set apart for orchard, vineyard, market-gardening, and forestry work, where experiments are being carried out in all branches of horticulture adapted to the district.

Special attention is devoted to the breeding and rearing of farm stock, and the production of mutton for export.

Vegetables of as many kinds as possible will be raised for experimental and commercial purposes, with and without irrigation.

A limited number of students will be instructed in the principles of agriculture and horticulture, as applied to all kinds of work carried out on the Farm; in field operations; the use of farm implements and machinery; dairying; the necessary carpentering and engineering required on a large farm; the care, breeding, and fattening of stock and poultry; bees; viticulture, fruit-preserving, and various branches of gardening and orchard work.

Wollongbar.

The Experimental Farm at Wollongbar, in the North Coast District, is situated near Lismore, on the Richmond River, and has an area of about 270 acres. The productions of this Farm are, of course, of an entirely different character to those of Bathurst or Wagga, all kinds of plants associated with semi-tropical climates forming the main features. Being in the midst of the dairying district, special attention is given to the raising of dairy cattle and the treatment of milk and cream. In the butter section students have the privilege of attending the Alstonville Butter Factory for practical training in the production of butter on a large scale. The area under cultivation is about 100 acres, the greater portion of this being used for experiments with fodder plants and grasses adapted for dairying purposes. There is accommodation for 12 students, and there are at the present time 9 students in residence. The fee for the full course of instruction is £25 per annum, payable half-yearly in advance; for special courses the fee is £2 2s. per quarter for non-resident students, and 10s. per week for residents.

This Farm is situated near Lismore, Richmond River, and the climatic condition and soils there are generally typical of the important dairying districts of the semi-tropical portion of the State known as the North Coast.

All kinds of crops suitable to a semi-tropical climate are grown for experimental purposes.

There is accommodation for the reception of twelve resident students in dairy work. Special facilities are afforded students for acquiring a knowledge of the various breeds of dairy cattle kept on the farm and bred for stud purposes; and in the management of dairy stock generally. Students will also be instructed in the methods of growing crops for fodder, and in the handling and treatment of milk and cream and manufacture of cheese.

Conditions of Admission to Wagga Wagga, Bathurst, and Wollongbar Experimental Farms.

Resident—Full Course Students.

Age.—Each candidate for admission must be over the age of 16 and under 41 years of age.

Parents and guardians of students under 21 years of age will be required to give an undertaking that they will at all times conform to the Rules and Regulations for the management of the Farm, and students over the age of 21 years shall give a similar undertaking.

Applications for admission of students will be received by the Director of Agriculture, Sydney, at any time; but a student is selected for appointment to a vacancy according to his qualifications.

Physique and general aptitude for farm-work will be considered in conjunction with the candidate's educational attainments.

Each applicant must produce a satisfactory testimonial as to character from his last teacher or employer, and a medical certificate from a duly qualified and registered medical man as to his state of health.

Non-Resident—Special Course Students.

From time to time, as the Minister for Agriculture may determine, there will be held special courses of practical instruction in various branches of farm, orchard, and stock work. Such courses will be open to adults, who must make their own arrangements for accommodation in the vicinity of the Farms, and who will be expected to give an undertaking to conform to the Rules and Regulations for the time being in force.

Fees.

A fee of £25 per annum, payable half-yearly in advance, will be charged for the maintenance and education of each resident student; and if, after the expiry of one month from the date of the payment of this fee, an enrolled student fail to put in an appearance at the Farm he shall then be considered disqualified, and the fee paid shall be forfeited, unless he can satisfy the Minister that his absence was due to some sufficient cause.

Students will be admitted for special courses at £2 2s. per quarter for non-residents, and at 10s. per week for residents, the latter payment covering board and lodging. At Berry Stud Farm the fee for the whole course is £2 2s., and £1 1s. for a special course of about three months in cattle breeding and management; but students must make their own arrangements for board and lodging.

Books and any scientific apparatus that may be required for individual use will have to be provided by students.

Each student must deposit the sum of £1 to defray any damage he may cause to farm property, &c., during his course.

Bursaries.

Bursaries may be awarded by the Hon. the Minister for Agriculture each year to those students whose parents' circumstances and their own aptitude and qualifications render deserving of this assistance. Special application must be made for these bursaries before the commencement of the Farm term.

Special Terms for ex-Students of the Hawkesbury Agricultural College.

The Minister has approved of students who have completed two years at the College, and whose general work and conduct have been satisfactory, proceeding to the Wagga Wagga, Bathurst, or Wollongbar Farms and working there for six or twelve months free of charge. It is considered that a term at either of these Farms will be of great value in supplementing, by a knowledge of local conditions, the practical portion of the education students have received at the College.

Special Course for Farmers' Sons at Wagga Farm.

The Minister has decided to offer the sons of farmers residing within 100 miles of the Wagga Wagga Farm an opportunity of acquiring, under specially favourable conditions, a thorough knowledge of the science and practice of farming.

Each candidate for admission must be over the age of 17 years.

Applications for admission of students will be received by the Director of Agriculture, Sydney, at any time; but students will be selected for appointment to vacancies according to qualifications, and subject to the approval of the Farm Manager.

The course of instruction will extend over six or twelve months, during which time students will receive instruction, and be granted board and lodging free of charge on paying an entrance fee of £3 3s.

Students will be required to submit a certificate from a Government Medical Officer to the effect that they are in sound health.

Students' Outfit.

Each resident student will require to provide himself with the following articles:—

- Two suits working-clothes.
- One suit for Sunday wear.
- Dairy students must provide themselves with a couple of white duck suits for wear in the factory.
- Two pairs suitable boots and one pair slippers.
- Hair-brush and comb.
- One clothes-brush.
- Four sheets.
- Three pillow-slips.
- Six strong bath-towels.

All wearing apparel, bed linen, etc., must be distinctly marked with the name of the student, otherwise it will not be taken to the laundry.

Concession in Rail Fares to Students.

The Railway Commissioners have been good enough to sanction the issue of rail tickets to Students proceeding to the Farms at half the holiday excursion rate. Certificates for presentation at the Railway Ticket Office will be issued upon application to the Manager of the Farm.

Farm

Farm Sessions.

For Full-course Resident Students the year will be divided into two sessions:—

First session, commencing 5th January and ending 23rd June.
Second session, commencing 1st July and ending 22nd December.

Examinations in all the subjects of the Farm course will be held at such times as may be deemed necessary by the Manager.

A Progress Examination will be held at the end of the first session; and any student failing to obtain 50 per cent. of the maximum marks in five of the subjects in that examination may not proceed with the work of the next session, unless by special permission.

At the end of the full course an Examination will be held, and to get the Farm Certificate the student must obtain at least 75 per cent. of marks in each subject of the syllabus.

The Manager shall report to the Minister any student who shall have failed to pass in a Sessional Examination.

Notice of Leaving Farms.

In the event of any student desiring to leave before the expiration of the complete course, one month's notice in writing must be given to the Manager, or, in default, a session's fee will be incurred, and be recoverable.

Discipline.

Each student shall conform to the Rules and Regulations for the time being in force for the government and management of the Farm, under penalty of expulsion, by order of the Minister, or of such lesser punishment as the Manager may impose. For Farm Rules, see next page.

Any student who is guilty, either within or without the Farm premises, of profane, immoral, or insubordinate conduct, or who after admonition wilfully breaks any of the Rules of the Farm, or persistently neglects his work, is liable to dismissal by the Minister.

The Minister may at any time direct that any student whose retention is likely to be unprofitable to the student himself, or injurious to other students, or prejudicial to the discipline or the reputation of the Institution, be not permitted to remain, and therefore such student's name shall be removed from the Farm Roll.

No punishments except such as the Manager approves shall be inflicted.

The Manager will allot to officers their respective duties on the Farm, and will have power to frame Rules and Regulations for the guidance of the students and all engaged on the Farm; such Rules and Regulations to be subject to the approval of the Minister.

Working Hours.

The hours of labour on the Farm and in the workshops are to be 48 actual, as follows:—Monday, Tuesday, Wednesday, Thursday, Friday, from 7·30 a.m. to 5 p.m.; Saturday, 7·30 a.m. to 1 p.m.,—with such intervals for meals as the Manager may determine.

The above hours shall apply only to the usual routine work of the Farm. During the time of sowing and harvesting, such instructions as are necessary will be issued by the Manager.

Dairy students shall at all times work according to a time-table to be arranged by the Manager.

Syllabus—Wollongbar Experimental Farm.

Dairy Students.

Special Dairy Course.

A course of six months' scientific and practical instruction in dairying is available.

Farm Dairy Work.

The dairy herd, breeding, rearing, selection, feeding, milking by hand and machines, housing, and general management.

Selection and preparation of sites for cow-sheds, dairies, and other farm buildings, and suitable equipment.

The management of pastures and production of forage crops, conservation of fodder, ensilage, hay.
Milk, its composition and physical characteristics and treatment.

Testing milk, estimation of acidity, detection of adulteration, and the general principles of modern dairy practice.

Butter-making.
Cheese-making (Cheddar).

Machinery and Appliances.

The management of separators; the care and management of engines, boilers, and refrigerating machinery; principles of construction.

Book-keeping.

To embrace the proper keeping of books and accounts for dairy farms, creameries, butter-factories; payment by results; the formation of Co-operative Companies.

Cattle Diseases.

Lectures will be given, with demonstrations, on the common ailments of, and injuries to, dairy stock; infective diseases, their diagnosis and treatment; castrating, speying, and application of the tuberculin test.

Examination for Certificates.

Examinations for the Special Dairy Certificate will be held the first week in January and the first week in July.

The practical examination will include dairy-farming, butter-making, and cheese-making, and the written examination will embrace a paper on each of these three subjects.

In order to secure a pass, students must obtain 50 per cent. of the maximum marks.

Farm

Farm Rules.

1. Farm students are to attend all lectures and examinations, unless specially exempted.

2. In the event of a lecturer being unable to deliver his lecture or carry on a class, the students concerned are to devote their time to practical agriculture, unless any other special study is assigned to them.

3. Students may leave the Farm bounds after 7 p.m., provided their general conduct is satisfactory, but must return to the Farm not later than 10 p.m. When extra leave is needed, special written permission must be obtained from the Manager, who alone can grant such leave. All such permits must be returned to the Manager, endorsed by the Officer-in-charge, and showing the exact time of return from leave.

4. Students are not to be absent from the Farm without leave from the Manager or Officer-in-charge. A book to be kept for the purpose of recording all such leave given.

5. Each student is required to keep a farm journal from his personal practical observation.

6. All games are expressly forbidden during the hours specified for lectures or classes. During lectures, classes, or working-hours, careful attention to the subject in hand is demanded.

7. Punctuality, order, and quietness are to be observed on the Farm at all times. Unpunctuality, disorder, and noise will render students liable to lose good conduct marks, or to be dealt with in such other way as the Manager may determine.

8. Any student who, without the sanction of the Manager, brings or causes to be brought into the Farm buildings or on to the Farm any fermented or spirituous liquors, or uses or has in his possession therein or thereon, without the permission of the Manager, firearms of any description, is liable to instant expulsion.

9. The habit of smoking is expressly discountenanced, and is prohibited at all times, except in places set apart for the purpose.

10. When any student is excused, through illness, from attending any lecture, class, or practical work, he is not to go beyond the bounds fixed by the Manager.

11. No student is allowed to bring any horse, dog, or other animal to the Farm.

12. All damages to the farm property caused by the students, jointly or individually, through neglect or carelessness, will be charged to their respective accounts. The decision of the Manager as regards the amount to be paid shall be final.

13. All cases of injury to animals and implements are to be reported without delay to the Manager.

14. Visitors are not allowed, without permission from the Manager, to inspect the buildings or to attend meals.

15. Students are required to obey the orders of the Manager, teaching staff, and those put in charge of them for the day.

16. No student is allowed to change his room without permission. At the close of a session senior and well-behaved students will have the preference, &c., as to the choice of any vacant rooms.

17. Students are forbidden to enter the kitchen, laundry, or any cottage or premises occupied by persons employed on the Farm.

18. Students are cautioned against interfering in any domestic arrangements and finding fault with the servants. Should there be any cause of complaint they are requested to speak to the Manager upon the subject.

19. Students render themselves liable to a fine of not less than one shilling for unpunctuality or breaches of discipline as the Manager may determine, and such fines shall be paid to the credit of the Farm prize fund.

20. Students are not allowed to frequent hotels in the town unless accompanied by parents or guardians.

21. Students must attend punctually at all meals, and must appear at the table clean and tidy; quietness and order must be observed.

22. The dormitory furniture will be booked to each student at the commencement of the session, and must be given over in the same good order and condition at its close. Students will be held liable for the same.

23. Any student being incapacitated by sickness and away from duty for more than two days consecutively must call in a medical man; and if he certifies that the student is in a fit condition to be moved, he must go home to his parents or guardians, or to some suitable place, for the purpose of obtaining proper attention, unless special permission to remain be obtained from the Manager. Although every attention will be paid to sick students in cases of sudden illness, it must be distinctly understood that the Department does not bind itself in any way to provide nursing or medical comforts.

24. Students will require to keep their work so well in hand that as the examinations approach they can regulate their studies so as to make the time at their disposal sufficient for due and complete preparation, as, owing to the work of the Farm having to be carried on with systematic regularity, under no circumstances can it be interfered with by the granting of extra time to students for private study at the cost of their practical duties, which are as important to them as their other studies and work.

25. During the time devoted to farm-work, students shall be under the control of the Farm Foreman or other officer, or such person or persons as may be appointed by the Manager; and the orders of the person in charge must be obeyed.

26. The Officer-in-charge will report to the Manager any breach of discipline or unsatisfactory conduct on the part of students under his control.

27. Students required to take charge of working-horses are to be at the stable at the time shown on the Farm time-table.

28. Students using tools and failing to return them to their proper places will be held responsible, and any student damaging implements, harness, gates, or other property on the Farm through carelessness or neglect will have to make the same good at his own expense. All such losses and breakages must be at once reported to the Manager.

29. No student will be permitted to enter the orchard or vineyard without the consent of the Manager, unless in the charge of one of the teaching staff for educational purposes, or when at work with the Orchardist.

30. Students are allowed access to all other parts of the Farm, but they are required not to disturb the stock or leave any of the gates open.

31. Students are invited to question the workmen on the Farm on matters pertaining to the work, implements, &c.; and any workman refusing to give the information sought, or answering in an uncivil manner, may be dismissed by the Manager.

32. Students in charge of animals must treat them in a humane and careful manner.

33. It is expected that all students will give timely notice to the Manager regarding the straying of stock, &c., and show generally an interest in the well-being of the Farm.

34. Students having charge of working-horses throughout the day must clean and otherwise attend to them.

35. Any neglect of the above Rules will be punished as the Manager may direct.

36. All officers and men connected with the Farm are expected to be punctual themselves, and to see that strict punctuality is observed by the students in all departments in which they are concerned.

Berry.

The area of the Berry Stud Farm is 327 acres, of which about 190 acres are cultivated, chiefly with fodder crops for the cattle on the Farm, of which there are about eight distinct breeds of the purest dairy strains of Great Britain and Holland. Students may here be instructed in cattle-breeding and dairy-farming, while arrangements have also been made whereby they may undergo a course of butter-making on a large scale at the Berry Central Butter Factory. Accommodation is not provided for resident students, but this can be obtained at reasonable rates on the neighbouring farms. The fee for the full course of instruction (12 months) is £2 2s. At present the opportunities afforded at this Farm are little availed of.

Berry Stud Farm.

Students may obtain instruction in dairy-farming, cattle-breeding, rearing and management, and butter-making in all its branches at the Berry Stud Farm, on the South Coast.

The primary object of the Dairy Stud Farm is to depasture imported stock, and raise therefrom a number of young animals which will in due course be offered for sale to the dairy-farmers of the State, thereby introducing new blood into our dairy herds.

The Farm is also utilised for the purpose of affording information as to the merits, demerits, and characteristics of the various breeds of dairy cattle, the treatment of milk and cream, and the manufacture of butter, as well as the cultivation of the various crops utilised for feeding dairy cattle.

Arrangements have been made with the proprietor of the Berry Central Butter Factory whereby students at the Farm may undergo a course in butter-making on a large scale, and in the management of creameries and dairy machinery in all its details. By this means it is expected that capable factory managers will be turned out, who will not alone be able to efficiently manage dairy factories, but will be able to afford information to the surrounding community on the merits of the various breeds of cattle, and their suitability or non-suitability to different localities and conditions.

Special Sessions.

For the convenience of students who have previously put in a term at one or other of the Government Farms, and for Creamery Managers, the Minister will, from time to time, arrange special sessions wherein most of the time shall be devoted to dairying work in the Berry Central Factory. For these special courses a fee of £2 2s. shall be charged.

Special Short Courses in the Breeding and Management of Pure-bred Dairy Cattle.

Special short courses of instruction, from two to three months in duration, may also be obtained in the breeding and management of pure-bred dairy cattle kept at Berry Stud Farm.

These courses are specially intended for students who have had a course at one of the Government Farms, but are open to any practical dairy farmers, or their sons, or those about to undertake dairying. The fee is £1 1s. for the course.

Syllabus—Berry Stud Farm.

Live Stock.

Students will be instructed in the breeding, rearing, feeding, and improvement of cattle, the characteristics of the various breeds of dairy stock, and their suitability to various conditions and climates; and also in the rearing of calves, and the feeding of calves and pigs.

The following breeds of cattle are kept on the Farm:—Shorthorns, Holstein-Fresians, Guernseys, Jerseys, Red Polls, Ayrshires, Kerries, and Dexter-Kerries, and practical instruction on each breed will be afforded.

Internal Dairy Work.

The testing of milk and cream, the separating of milk, the management of dairy machinery, and the principles of butter and cheese making, will be taught; and further instruction in the manufacture of butter on a commercial scale, as well as the general management of a central butter factory, can be had at the Berry Central Factory.

Examinations

Examinations for Certificates.

Students entering for examination in Dairy-farming will be examined practically in all that pertains to the milking of cattle, the separating of milk, the rearing of calves and pigs, and the general treatment, feeding, breeding, and management of dairy stock. Papers will also be set embracing these subjects.

To obtain a Certificate for Butter-Making and Factory Management, students will be put through a practical examination in the testing and separating of milk, the pasteurising of milk and cream, the ripening of cream, both naturally and artificially, and the manufacture of butter; as well as in the working of dairy machinery, including refrigerators. Papers will also be set embracing these subjects.

Books Recommended for Study by Students.

The Agricultural Gazette of N.S.W.
"The Australian Dairy Book," by M. A. O'Callaghan.
"British Dairy Farming," by Professor Long.
"Cattle: Breeds and Management," by William Housman.
"The Story of Germ Life," by H. W. Conn.
"Dairy Bacteriology," by Freudenreich.
"Milk and its Products," by Wing.
"Cheese-making," by Prof. Long and J. Benson.

Lectures.

Lectures will be delivered by the Dairy Expert to special course students, embracing the subjects mentioned in the above Syllabus. Lectures and practical instruction will be given by the Manager on the crops of the Farm.

In the Central Factory, instruction will be given to students by the Manager, and also by an officer of the Dairy Branch of the Department of Agriculture.

Students who have completed the full course of two years at the Hawkesbury Agricultural College, and whose work and conduct are satisfactory, may obtain admission free of charge, for 6 or 12 months, at Wagga, Bathurst, Wollongbar, or Berry.

CHAPTER L.

CHAPTER L.

Commercial Education in Great Britain.

[J. W. TURNER.]

Introduction.—The subject of commercial education is one of great importance, and its place in the school curriculum is one of widespread interest among educationalists.

In 1899 a special sub-Committee appointed by the Technical Education Board, London County Council, to consider and report upon the special agencies which exist within the County of London for giving commercial education, and to suggest plans for establishing other agencies and increasing the efficiency of those already in existence, presented its report after a most exhaustive inquiry into Continental commercial methods, and a large number of interviews with representative business men.

As there is much in the report which bears on our own circumstances, it is proposed to enumerate some of the most important points decided by the Committee.

Committee's Report—English Opinions.

Instruction in Elementary Schools.—Dealing first with the elementary day schools, the Committee referred to the unanimous decision of the Antwerp Congress, in 1898, against specialisation on commercial subjects in primary schools, and considered that whatever branch of commercial life a boy intended to enter it was necessary he should receive as good a general education as was possible in the elementary school. The Committee emphasised the importance of bringing the teaching of the elementary school more into relation with actual every-day life, and making the instruction practical in its application.

The Committee laid great stress upon the necessity for the universal teaching in elementary schools of the decimal system in its application to all branches of arithmetic, especially money, and of the metric system in its relation to weights and measures, and directed attention to the importance of the teaching of mental arithmetic in ordinary business affairs of home life.

Instruction in the Higher Grade Schools.—The Committee favoured the organisation of higher grade departments in connection with elementary schools which, while continuing the general education, would give a more specialised training to boys entering business about the age of 14 years. On the question of teaching shorthand and typewriting in the higher grade schools, subjects which Professor Layton, of Antwerp Higher Commercial School (who gave evidence before the Committee), regarded rather as "useful accomplishments" than as "educational specialisation," the Committee saw, in these subjects, a considerable amount of training value, and decided to recommend them in the higher grade curriculum so long as the more general education was carried on at the same time.

Instruction in Secondary Schools, Second Grade.—In dealing with the secondary day schools, the Committee classified them as second grade, pupils leaving about the age of 16 years, and first grade, pupils staying on to the age of 18 or 19, and outlined a scheme of commercial work for the requirements of each class.

The second grade secondary schools, the Committee suggested, would serve mainly for training students for positions as commercial travellers, agents, managers of departments; the first grade schools for training students for the most responsible positions in banks, insurance houses, mercantile houses, etc. The principal subjects in the second grade secondary schools would be modern languages, mathematics, science, English literature, history and geography. Latin was not recommended, because the Committee was of opinion that an equally efficient training for boys destined for commercial life could be given by modern languages if taught on right principles. The Committee attached the greatest importance to a thorough familiarity with foreign languages, not only conversational as between business men on business matters, or as printed in books, but also as written, and recommended that in the higher classes of the second-grade secondary schools practice should be given in reading foreign handwriting, and even in learning how to write a foreign letter.

Model Business houses.—On the question of the desirability of introducing model business houses into the secondary schools with specialised courses for commercial instruction, such as exist in some Continental commercial schools and American colleges, the Committee favoured the bureaux of Antwerp and Neuchatel as valuable auxiliaries in teaching, but considered the American accessories of office fittings as not only unnecessary, but likely to bring the system into ridicule as a childish "playing at business."

Instruction in Secondary Schools, First Grade.—In suggesting the scheme of commercial work for the first grade secondary schools, the Committee pointed out very clearly the important position that foreign languages should hold in the instruction, and the necessity for teaching them by Englishmen who had obtained practical

practical knowledge of business life on the Continent. The Committee, with exceptions in the case of certain subjects, disapproved of specialised commercial work as conducted in commercial bureaux, and recommended the study of British and foreign history and geography, with special reference to the growth and organisation of international trade, a course in political economy, a knowledge of the principles of international and commercial law, a course in mathematics, and a graduated course in experimental science. The Committee was of opinion that the only examination for a school of the first grade should be for admission to the higher institution, where further specialised instruction would be given in connection with a university. The examination should be largely oral, should be framed so as to fetter the teaching as little as possible, and should be a leaving examination like the German *Abiturienten Examen*, or the French *Baccalauréat*. As in the case of the second grade school, the examination should qualify for admission to the higher institution, or in the case of those entering a business, for a certificate. The work of the London Chamber of Commerce in establishing the junior and senior examinations for students of commercial education, and issuing corresponding certificates, was acknowledged in the report, and the hope expressed that it would continue to conduct examinations and use its influence in the commercial world to secure a proper valuation for the certificates.

Co-operation of Commercial Men.—In order to bring about the greatest development of commercial education in the London County Council schools, the Committee urged, as most important matters—(*a*) The co-operation and interest of commercial men in the schools, so as to insure that the work should be in touch with the commercial world; (*b*) the training of teachers, especially modern language teachers, to carry on the instruction as recommended in the first and second grade secondary schools. The Committee was most emphatic in recommending the infusion of a strong element from the world of commerce into the governing bodies of such schools. The success of some Continental commercial schools was attributed, in a great measure, to the hearty support given by their business men, and the evidence of the headmaster of the Central Foundation School, London, who pointed out how much English merchants could do if they would take account of educational qualifications in making appointments, was specially quoted to show what teachers thought of the need for a closer acquaintance between the schools and the business employers.

Training of Teachers for Commercial Schools.—The training of teachers for the commercial schools was recognised by the Committee as a subject of very great importance, and it was decided that the preparation for positions in the types of schools described above should be the work of a higher commercial school of University standing, supplemented by travelling scholarships to enable the holders to study the methods of foreign commercial teaching.

Commercial Teaching in Evening Classes.—The Committee recommended that the work of the evening classes in Continuation Schools should be mainly supplementary to the courses of day commercial instruction, and that the range of subjects should be extended, and the instruction co-ordinated to the actual requirements of commercial life.

University Commercial Education.—In regard to commercial institutions of University rank, the Committee regarded it as important that higher commercial education should be distinctly recognised as constituting a separate faculty in the London University. Such University recognition was essential in the opinion of the Committee to give status to the higher branches of commercial education, and to increase their attractiveness to students of the highest mental capacity. It was also of the utmost importance to commercial education itself, as tending to insure a high intellectual standard, and to counteract any tendency to an unduly narrow utilitarianism. The higher commercial education, as defined in the prospectus of the London School of Economics, and accepted by the Committee, "is a system of higher education which stands in the same relation to the life and calling of the manufacturer, the merchant, and other men of business, as the medical schools of the Universities to that of the doctor—a system, that is, which provides a scientific training in the structure and organisation of modern industry and commerce and the general causes and criteria of prosperity, as they are illustrated or explained in the policy and the experience of the British Empire and foreign countries."

(A faculty of commerce now exists in each of the Universities of London and Birmingham.)

Committee's Recommendations.—Some of the Committee's specific recommendations which appear to have most interest for this State are:—

That, to meet the needs of those who enter business offices about the age of 14, day continuation schools are required, which should give a two years' course of training specially adapted for commercial life.

That it is desirable that there should be in many of the public secondary schools in London, second grade departments, devoting themselves primarily and avowedly to the preparation for commercial life of boys who will leave school at 16; that in such departments, while a good general education should be given, special attention should be devoted to modern languages in such a way as to turn out pupils able to speak and correspond fluently in at least two modern languages; to the teaching of arithmetic so as to secure perfect facility in the use of the metric system; and to ensuring a good general acquaintance with the commercial geography of foreign countries.

That it is desirable that there should be provided in London, in one or more of the existing public secondary schools of the first grade, departments devoting themselves primarily and avowedly to the preparation for business life of boys leaving school at 18 or 19; that the curriculum of such department should not lead up to a classical or mathematical career at the University, but should qualify its pupils either to enter the higher ranks of commercial life or to pursue an advanced course of study in the economic and commercial faculty of the new London University, or in other institutions of higher commercial education.

That it is desirable that full and express recognition should be given to higher commercial education in the reorganisation of London University.

That

That efforts be made by the Board to extend, improve, and co-ordinate the teaching of commercial subjects in evening classes, especially in such departments as foreign languages, the metric system of weights and measures, economics, commercial history and geography, shorthand, and book-keeping.

That special efforts be made by the Board to obtain the co-operation of representatives of different branches of the business world in carrying out this programme; and that negotiations be entered into with the London Chamber of Commerce, the Institute of Bankers, the Institute of Actuaries, and other associations holding examinations in commercial subjects, with a view to securing their co-operation, especially in obtaining the recognition by commercial men of leaving certificates, and in securing a closer union between the teaching and examining bodies.

Other British Expert Opinions on the Teaching of Commercial Subjects.

Some two years ago a few leaders of commerce in England were asked to give their opinions on what was considered essential in the educational equipment of a young man intended for business. Their replies, which are quoted in part in this chapter, appear in the opening chapters of "The King's Weigh House Lectures to Business Men," which were delivered at King's Weigh House, Grosvenor Square, in connection with the establishment of the Evening Commercial School, Barrett Street, by the London School Board, in 1901.

Sir Thomas Sutherland, Chairman and Managing Director of the P. & O. Steamship Company, says:—"I have some doubt whether the outcry for specialised education towards a commercial career is necessary. If a lad has to take his chance of an opening wherever he may find one, he is quite as likely to hit the bull's eye by the help of a good sound general education as by any other means. . . . What we may learn from the Germans is the art of taking pains in the minutest things. . . . A first-rate man of business is formed of various parts which are not the result of any peculiar system of education, but are due to energy of character and clearness of head, ... qualities which may be improved by practice and steady effort."

Sir Owen Roberts (of the Worshipful Company of Clothworkers), answers:—"A good general education, including a working knowledge of, and familiarity with, at least two modern languages, conversancy with the problems of economical science, rapid and intelligent modes of calculation, knowledge of modern history, and the rise, decay, and fall of industrial communities. Above all, a sense of honor and duty in all the relations of life, founded on conviction and principle."

Thos. F. Blackwell, Esq., Chairman of Council of the London Chamber of Commerce, writes:—"For a youth who wishes to become a junior clerk, a good, clear, and quick handwriting is of the first importance, next correctness and rapidity in simple arithmetic. The possession of industry, thoroughness, loyalty, and straightforwardness is of great importness. He will then place duty to his business before amusement, and gain the confidence and goodwill of his employers and of all with whom he comes into contact."

Mr. M. E. Sadler, in contributing a valuable article on "England's Need of Commercial Education" to "The King's Weigh House Lectures," says:—"There is no cut-and-dried formula for 'commercial education,' which fits all cases and all conditions of men and women. Remember that what you want is not knowledge alone, or energy alone, or good manners alone, or sharpness alone, or a strong sense of duty alone, or good physical condition alone, or firmness of purpose alone, but a due admixture of each and all of these. For a promising boy with an aptitude for business, a good constitution, a clear head, a strong sense of duty, and a determination to make his own way in the world, there is no endowment like a good general education. We do not want commercial schools which will turn out tame experts whom employers can keep in cupboards on small salaries. We want young men of sturdy moral character; vigorous in body; capable of forming independent judgments; trained to observe accurately, to report exactly, to reason correctly. . . . . Also, equally important, we want progressive employers who make a point of giving promising employees the right kind of training inside the business. . . . There needs to be something little short of a revolution in our ordinary methods of teaching modern languages, and in the place held by the mother tongue, by English History, and by the knowledge of nature and of geography, in the curriculum of many of our schools. . . . . At the top of a thoroughly efficient and 'live' system of general and unspecialised secondary education we need specialised commercial schools and classes of many different types and of several grades. But these must work in very closely with the actual needs of business houses."

The whole of this article by Mr. Sadler, and "Hints on the Conduct of Business, Public and Private," by the late Sir Courtenay Boyle, are recommended as worthy of attention by commercial students and teachers.

In another direction, entirely unconnected with the King's Weigh House Lectures, but still contributing to the general question of commercial teaching in schools, Mr. Sidney Webb, whose long connection with the London Technical Education Board, and whose recent appointment on the Royal Commission to deal with trades unions and the relations of capital and labour, entitle his opinions to some weight, says in his paper, "Culture in Commerce":—"English business is not being driven to the wall because of a dearth of qualified clerks and trained office-boys. Let us by all means see that everyone, be he office-boy or partner, gets the best possible school training, and the utmost possible facility for evening instruction. But what is lacking in our business management is not the power of writing or speaking Spanish and Russian, or the capacity of quoting prices in the metric system, but the imagination which recognises the importance of these things, the intellectual alertness which is quick to see the need for change, and the practical resourcefulness which promptly finds an appropriate alternative for every shifting of industrial conditions. What we have to do, in fact, is to train our business men, be they clerks or partners, not merely, or even chiefly, to discharge their office routine, but to let their intellect play round their business—to put into their work not only brains, but brains of the highest or inventive kind. This is where they seem at present to fall behind the German and the American."

Commercial Education in Elementary Grades.

The schools which afford the best illustration of elementary commercial education systematically given are found in the upper primary schools of France and the higher grade schools of England and Scotland. One of the specialised branches of instruction in the French schools is the teaching of commercial subjects, and the object of the instruction is to give the pupils a bias towards business life. The course in the higher grade schools is arranged to suit the requirements of both boys and girls who are preparing for entrance upon a business career, and special attention is given to the following subjects:—English, French, German, commercial arithmetic, commercial geography, book-keeping, shorthand, and typewriting. Pupils enter the special classes of the higher grade schools, as a rule, about the age of 13, and the course extends over three years. On the completion of the course, many of the pupils present themselves for junior commercial certificates issued by the London Chamber of Commerce and similar commercial institutions.

The splendid system of evening continuation schools which exist in all the large towns of the United Kingdom affords excellent opportunities for a commercial training to those children who cannot remain at the day schools to take advantage of the specialised course. The evening classes in Leeds and Manchester give special encouragement to pupils taking up the commercial courses. (*See* chapter on Continuation Schools.)

The Manchester School Board provides for the teaching of modern languages (usually French and German, but sometimes Spanish added) in all its evening commercial schools, and offers in its special commercial classes for men and women a range of commercial subjects of very high standard. The Leeds School Board does not give so much prominence to modern languages (French only being taught) in its evening classes, but it offers a supplementary free course of manual training.

London Chamber of Commerce—Junior Commercial Course.

The London Chamber of Commerce issues from year to year, for the benefit of school teachers and pupils, a scheme and syllabus of junior commercial education, and conducts examinations for junior commercial education certificates.

The scheme of work, the Chamber points out, is only to be regarded as indicating the general lines on which commercial education should be conducted. The Chamber draws special attention to the fact that in its scheme it requires a sound general education before special commercial subjects are introduced, and it suggests that the latter should be introduced, as a general rule, at the stage of knowledge reached by an average boy of about 15 years of age.

The pupils of the higher grade Board Schools and the evening commercial continuation schools in England are among the regular candidates for the junior certificates of the London Chamber of Commerce.

The scheme, or some modification of it, may be useful to those of our own teachers who intend to add commercial subjects to their programme, as recommended in Chapter LVI, Primary Instruction, and for this reason the syllabus is given in full.

LONDON CHAMBER OF COMMERCE, JUNIOR COMMERCIAL COURSE.

First Year, for Students from about 10-12 Years of Age.

English and Writing.—Eight lessons per week.
Spelling and Dictation, Reading (recognised English Classics, not mere Reading Books, to be employed), Recitation, Knowledge of the Parts of Speech, Simple Composition, etc., Writing.
History.—Two lessons per week.
History of England.
French or German.—Six lessons per week.
Pronunciation, Acquisition of Words and Phrases, Dictation, Elementary Grammar, Reading and Translation into English, Recitation of Passages learned by heart.
Geography.—Three lessons per week.
Elementary facts of General Geography, and Elements of Geography of the British Isles.
Mathematics.—Seven lessons per week.
Arithmetic, including Elements of Vulgar Fractions and Decimals; Mental Arithmetic and Rapid Calculation; Simple Geometry, Employment of Rule, Square, Compasses, etc.
Elementary Science (Lectures on Elementary Physiography).—One lesson per week.
Drawing.—Two lessons per week.
Elements of Freehand Drawing.

Time-table for First Year.

	Lessons per week.
English and Writing	8
History	2
French or German	6
Geography	3
Mathematics—	
Arithmetic—Geometry	7
Elementary Science	1
Drawing	2
	29

Not much preparation out of school hours will be necessary at this stage, or during the next year.

Second Year, for Students from 11-13 Years of Age.

Mathematics.—Six lessons per week.
Arithmetic.—Long Tots, Cross Tots, Decimal Calculation, Square Root, Proportion, Practice, Simple Interest, Mental Arithmetic and Rapid Calculation, Simple Constructive Geometry.
English and Writing.—Six lessons per week.
Spelling, Reading and Recitation, Exercises upon Grammar, Etymology, Simple Composition. Writing—using, as copies, bills, letters, circulars, etc., both in English and in French or German.
French or German (whichever was commenced in preceding year).—Five lessons per week.
Continuation of Exercises of preceding year.

German

German or French.—Five lessons per week.
Pronunciation, Acquisition of Words and Phrases, Dictation, Elementary Grammar, Reading, Recitation of Passages learned by heart.
History.—Two lessons per week.
Continuation of History of England.
Geography.—Two lessons per week.
General Geography of Europe, Configuration, Climates, etc.; principal seas, mountains, rivers, etc. European States—their chief characteristics, physical and political geography, principal towns, population, military forces, &c.
Elementary Economic Geography, with special reference to agriculture, mines, industries, and chief modes of communication.
Elementary Science (Physics, or Natural History, or both).—Two lessons per week.
Make optional or alternative :—Physics; Botany (Essential parts of a Plant, Methods of Nutrition, general characters of different groups of Plants as exemplified by certain types). The pupils should themselves dissect and describe plants.
Drawing.—Two lessons per week.
Freehand Drawing, Outline and Shading of Geometrical figures and of simple objects of daily use.
Geometrical Drawing, with the use of Scales, Simple Designs, the use of Indian ink.

Time-table for Second Year.

	Lessons per week.
English and Writing	6
French	5
German	5
History	2
Geography	2
Mathematics	6
Elementary Science	2
Drawing	2
	30

Third Year, for Students from 12–14 Years of age.

English and Writing.—Six lessons per week.
Spelling, Reading, and Recitation; Analysis of Sentences, rules essential in Composition, especially in the form of reproduction of stories read. Writing, using copies in foreign languages as well as English, as in second year.
French.—Five lessons per week.
Continuation of Exercises of preceding year, with Conversational Exercises.
German.—Five lessons per week. As French.
History.—Two lessons per week.
History of England, with Literary History and Contemporaneous General History.
Geography.—Two lessons per week.
General Geography, Physical and Economic, of the British Isles and their Possessions, and main routes of traffic.
Mathematics.—Five lessons per week.
Arithmetic.—Proportion, Practice, Interest, Discount, Stocks, Mental Arithmetic and Rapid Calculation.
Algebra.—Elementary Rules, Simple Equations.
Geometry.—Euclid : Book I. to Prop. 20.
Make optional or alternative.—Physics, two lessons per week; Chemistry, two lessons per week.
Natural History.—One lesson per week.
Elements of Zoology.
Drawing.—Two lessons per week.
Drawing and Shading from Simple Objects, from Cubes, Spheres, from Bas-reliefs of leaves, Ornamental Flowers, etc., from Architectural Fragments; Elements of Perspective or Geometrical Drawing, Projection of Simple Solid Objects, Elementary Architectural Drawing.

Time-table for Third Year.

	Lessons per week.	
English and Writing	6	
French	5	
German	5	
History	2	
Geography	2	
Mathematics	5	
Physics or Chemistry	2	Or add lessons to Mathematics or Languages.
Natural History	1	
Drawing	2	
	30	

In this and the following years, two or three hours' daily preparation out of school will be desirable.

Fourth Year, for Students from 13–15 Years of Age.

English and Writing.—Four lessons per week.
Literature, Language, Composition, Writing in English and German characters, Shorthand.
French.—Five lessons per week.
Continuation of exercises of preceding year. Conversational Exercises, Dictation, Composition of Simple Letters, Essays, etc.; Reading and Translation.
German, or Spanish, or Portuguese, or Italian.—Five lessons per week. The same course to be pursued in commencing a new language as with French and German.
Latin.—Optional subject.
History.—Two lessons per week.
Brief course of Ancient History, with special reference to Colonies and Commerce; revision of English History.
Geography.—Two lessons per week.
Commercial Geography of the British Isles, including Agriculture, Animal Produce, Mineral, Textile, and Chemical Industries, Commerce, Railways, Steamboat Service, Colonisation; Physical Geography of Africa, Asia, America, and Oceania.
Mathematics.—Five lessons per week.
Arithmetic.—Stocks; Exchanges; Metric System; Mental Arithmetic and Rapid Calculation.
Algebra.—Factors and Fractions. G.C.M. and L.C.M.; Quadratics, Logarithms, Elements of Logarithmic Calculation.
Geometry.—Euclid : Book I.

Natural

Natural History.—One lesson per week.
Elementary facts of Physiology.
Make optional or alternative :—Physics, two lessons per week ; Chemistry, two lessons per week.
Book-keeping, etc.—Two lessons per week.
Theory of Accounts, Balancing, Profit and Loss, Book-keeping, International Exchanges, etc.
Moneys, etc.
Drawing.—Two lessons per week.
Freehand Drawing from simple casts, Human figure from bas-reliefs, Elementary Anatomy or Geometrical Drawing, Architectural Studies, Mechanical Drawing, Machines, etc.

Time-table for Fourth Year.

	Lessons per week.
English and Writing	4
French	5
German, or Spanish, or Italian, or Portuguese	5
History	2
Geography	2
Mathematics	5
Natural History	1
Physics or Chemistry, or optional subjects	2
Book-keeping	2
Drawing	2
	30

FIFTH YEAR, FOR STUDENTS OF 14–16 YEARS OF AGE.

English and Writing.—Four lessons per week.
Literature, Language, Composition, Writing, Shorthand.
French.—Five lessons per week.
Continuation of exercises of preceding year. Formation and Composition of words, Literature, Conversation, Correspondence.
German, or Spanish, or Portuguese, or Italian.—Five lessons per week.
Continuation of exercises of preceding year.
Latin.—Optional subject.
History.—Two lessons per week.
Commercial History of the Middle Ages and Modern Times, Geographical discoveries.
Geography.—Two lessons per week.
European Commercial Geography, including Agriculture, Industries, Commerce.
Mathematics.—Five lessons per week.
Keep up general exercises, especially in Mental Arithmetic and Rapid Calculation.
Algebra.—Quadratics, further application of Logarithms.
Trigonometry.—Definitions, Measurement of Angles, Simple Applications.
Geometry.—Euclid : Books I–IV and Mensuration.
Mechanics.—Principles of Energy, Mechanical Powers, Work done by Machines, Hydrostatics.
Book-keeping, etc.—Two lessons per week.
Make optional or alternative :—Physics, two lessons per week ; Chemistry, two lessons per week.
Natural History.—One lesson per week.
General Anatomy and Physiology, human and comparative, Digestion, Absorption, Circulation, Respiration, Innervation, Locomotion.
Or, Geology.
Drawing.—Two lessons per week.
Advance on preceding work, Geometrical Drawing, Perspective, Architectural Drawing, Machinery, etc. History of Art, Introductory.

Time table for Fifth Year.

	Lessons per week.
English and Writing	4
French	5
German, or Spanish, or Italian, or Portuguese	5
History	2
Geography	2
Mathematics	5
Book-keeping, etc.	2
Physics, or Chemistry, or optional subjects	2
Natural History or Geology	1
Drawing	2
	30

SIXTH YEAR, FOR STUDENTS OF 15–17 YEARS OF AGE.

English and Writing.—Four lessons per week.
Literature, Language, Composition, Writing, Shorthand.
French.—Four lessons per week. French to be spoken.
Syntax, Idioms, Literature, Composition of Commercial Letters, etc.
German, or Spanish, or Portuguese, or Italian.—Four lessons per week.
Continuation of exercises of preceding year.
Latin.—Optional subject.
History.—Two lessons per week.
Contemporaneous Commercial History.
Geography.—Two lessons per week.
Commercial Geography of Africa, Asia, Oceania, America, Animal and Vegetable Produce, Mines, Metals and Precious Stones, Industries, Markets, Ports, Means of Transit.
Commerce and Commercial Law.—Two Lessons per week.
Commerce, Commercial Contracts, Insolvency and Bankruptcy, Commercial Law, Industrial Law, Chambers of Commerce, Patents, etc.

Mathematics.

Mathematics.—Five lessons per week.
- Arithmetic.—Keep up Mental Arithmetic and Rapid Calculation.
- Algebra.—Binominal Theorem, and higher work.
- Geometry.—Euclid : Books I–IV and XI (optional), and Mensuration.
- Mechanics.—Kinematics, Kinetics, Dynamics.
- Cosmography of the Earth, Sun, Moon, Planets, Comets, etc.

Book-keeping, etc.—One lesson per week.

Make optional or alternative :—Physics, two lessons per week ; Chemistry, two lessons per week.

Political Economy.—Two lessons per week.
- Its aim : Production of Riches, Distribution of Riches, Exchanges, Money, Credit, Saving, Luxury, Application to Financial Legislation.

Drawing.—Two lessons per week.
- Repetition of the work of the preceding year, Composition, Geometrical, Designing, History of Art ; or, Photography, Photo-gravure, Engraving, Etching, Painting, Sculpture, etc. The History in either case.

Time-table for Sixth Year.

	Lessons per week.
English and Writing	4
French	4
German, or Spanish, or Portuguese, or Italian	4
History	2
Geography	2
Commerce and Commercial Law	2
Mathematics	5
Book-keeping, etc.	1
Physics, or Chemistry, or optional subjects	2
Political Economy	2
Drawing	2
	30

NOTE.

French Scheme.

In drawing up this scheme careful attention has been given to the French *Plan d'Etudes de l'enseignement Secondaire Spécial* and to the chief German schemes, of which tables are given below.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	6th year.
French	7	5	4	3	4	2
Living Languages	5	5	4 { p s	2 3	2 3	2 3
History	2	2	2	1	1	1
Geography	1	1	1	2	1	1
Mathematics	3	4	4	4	6	6
Natural History	2	1	....	2	2	2
Physics	....	2	2	2	2	2
Chemistry	....	....	2	2	2	2
Commerce	....	....	1	1	....	....
Morals	....	....	....	1	....	....
Legislation	....	....	....	2	....	....
Political Economy	....	....	....	....	2	....
Philosophy	....	....	....	....	....	4
Commercial and Industrial Law	....	....	....	....	....	2
Writing	2	1	1	....	....	....
Drawing	4	4	4	4	4	4
Lessons per week	26	25	25	29	29	31

Munich Scheme.

In the Munich course of six years there is no Latin, and drawing is not taught during the fifth and sixth years.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	6th year.
Religion	2	2	1	1	1	1
German	6	6	4	5	5	5
French	6	6	5	4	4	4
English	....	....	5	4	4	4
Mathematics and Arithmetic	6	6	6	7	6	6
Geography and History	3	3	4	4	4	4
Natural Sciences	2	2	3	4	5	5
Commercial Science, Book-keeping, and Correspondence	....	....	....	....	4	4
Caligraphy	2	2	1	1	....	....
Drawing	2	2	2	2	....	....
Gymnastics	2	2	2	2	2	2
Lessons per week	31	31	34	34	35	35

Leipzig

Leipzig Scheme.

At Leipzig, where there is a three years' course, there is no Latin. There is, however, instruction in Mechanical Technology and in Commercial Commodities, thus :—

	1st year.	2nd year.	3rd year.
German	4	3	3
English	5	4	3
French	5	4	4
Mathematics	3	3	3
Mercantile Arithmetic	5	3	2
Physics	3	2	....
Mechanical Technology	....	... .	2
Chemistry	....	2	2
Practical Acquaintance with Articles of Commerce	....	....	1
Geography	2	2	2
History	2	2	2
Commercial Science, including Commercial Law	....	2	2
Counting-house Work	... .	2	.. ..
Correspondence	....	....	2
Book-keeping	....	....	2
Political Economy	....	....	2
Caligraphy	3	2	2
Drawing	2	2	....
Gymnastics	2	2	2
Lessons per week	36	35	36
Non-obligatory subjects—			
Italian	....	2	2
Shorthand	2	1	1

SYLLABUS OF THE JUNIOR EXAMINATION FOR COMMERCIAL EDUCATION CERTIFICATES, LONDON, 1902.

Students to be examined and classed at the end of each year in all the subjects previously learned, but with special reference to the subjects studied during the year ; and at the end of the sixth year of Secondary Commercial School Life, *i.e.*, at the age of 16 or 17, they should pass an examination as follows, the standard of knowledge expected being that of the final year. In order to obtain a Junior Commercial Education Certificate, candidates will be required at present to pass in each of the obligatory subjects (a, b, c, d), and in at least one group, but not more than two of the optional groups of subjects.

I.—Subjects of Examination.

1.—Obligatory Subjects.

(a) English Essay, including Handwriting and Orthography, and Analysis.
(b) Arithmetic, including a knowledge of the Metric System.
(c) A Modern Foreign Language, comprising Translation, Dictation, Composition, and Conversation.
(d) Elementary Drawing—(Freehand or Geometrical or Designing).
(e) Elementary Chemistry or Physics (one of which must be studied practically).

2.—Optional Subjects.

Group A.—Mercantile.

At least two, but not more than four of the following : —

i. Commercial Arithmetic, including Book-keeping.
ii. History, including Commercial History and the Elements of Political Economy.
iii. Commercial Geography.
iv. Advanced Drawing, either Freehand and Model or Designing or Mechanical or Geometrical or Perspective.
v. Shorthand.
vi. Typewriting.

Group B.—Linguistic.

At least two, but not more than four of the following :—

i. French.
ii. German.
iii. Spanish.
iv. Portuguese.
v. Russian.
vi. Italian.

Latin may be taken, but does not count as one of the necessary languages

Group C.—Mathematical.

At least two, but not more than four of the following :—

i. Algebra.
ii. Euclid.
iii. Trigonometry.
iv. Statics.
v. Dynamics.
vi. Hydrostatics.

Group D.—Scientific.

At least two, but not more than four of the following :—

i. Chemistry.*
ii. Sound, Light, and Heat.*
iii. Electricity and Magnetism.*
iv. Botany.*
v. Geology.*
vi. Mechanics.

* Practical work is essential.

Upon passing this examination (of which further details are given below) the student will receive a Junior Commercial Education Certificate, upon which will be entered a list of the subjects in which he has passed, with special mention of those in which he has distinguished himself.

The following are further details of the knowledge required under the aforementioned obligatory and optional subjects, in the examination for the Junior Commercial Education Certificate.

Obligatory.

(a) English Essay, including Handwriting, Dictation, Orthography, Composition, and Analysis.
(b) Arithmetic, including thorough familiarity with Arithmetical Theory and Practice, and particularly a knowledge of the Metric System, and Mental Arithmetic.
(c) A Modern Foreign Language, comprising Conversation, Translation, Dictation, and Composition.
(d) Elementary Drawing—Freehand or Geometrical or Designing.
(e) Elementary Chemistry or Physics. Theoretical—(i) Elementary Inorganic Chemistry, or either (ii) Sound, Light, and Heat, together with Weighing and Measuring, or (iii) Electricity and Magnetism. Practical—Either (i), (ii), or (iii) as above, but only one to be taken.

Optional.

Optional.

Group A.—Mercantile.

1. Commercial Arithmetic and Book-keeping.—A general knowledge of Foreign Weights and Measures, Currencies, and Exchanges is required, with approximations.
2. History.—Including Commercial History of the British Isles, Colonies, and Dependencies. Political Economy—Its aim, production of riches, exchanges, money, credit, saving, luxury, application to financial legislation.
3. Commercial Geography, including Physical, Political, Commercial, and Industrial Geography of the British Isles, Colonies, and Dependencies.
4. Drawing.—Advanced Freehand and Model or Advanced Designing, or Advanced Mechanical, or Advanced Geometrical, or Perspective.
5. Shorthand.—Writing in Shorthand (any system) from passages dictated at the rate of seventy and eighty words per minute; transcription of the Shorthand. Spelling, punctuation, and neatness of writing in transcription will be taken into account in judging of the candidates' work.
6. Typewriting.—Copying in correct form commercial letters and tabular statements from manuscript copy. Credit will be given for neatness, speed (as shown by the amount of work completed), correct spelling, syllabication and punctuation, and general intelligence. Candidates will be allowed to use any make of instrument they choose, and those in a position to bring their own instruments are recommended to do so.

Group B.—Linguistic.

French, German, Spanish, Portuguese, Russian, Italian.—Translation into and out of English, Dictation, Grammar, Conversation, Composition. Latin may be taken but does not count as one of the necessary languages.

Group C.—Mathematical.

1. Algebra.—Up to Quadratic Equations inclusive, together with easy examples on Indices, Rates, Proportion, Variation and the Progressions, and the Elementary Theory of Logarithms.
2. Euclid.—Books I, II, III, and IV, and the first 19 propositions of Book VI, together with easy problems thereon.
3. Trigonometry.—Up to and including the Solutions of Triangles and the use of Logarithmic Tables, and easy examples in Mensuration.
4. Statics.—The equilibrium of forces acting in one plane, and of parallel forces, the centre of gravity, the mechanical powers and friction.
5. Dynamics.—Motion, velocity, acceleration, momentum, force, work, energy, power, impact.
6. Hydrostatics and Pneumatics.—The simpler properties of matter in the solid, liquid, and gaseous states, pressures of liquids and gases, Boyle's law, pumps, syphons, etc.

Group D.—Scientific.

1. Chemistry—
   (i) Theoretical.—Chemical and physical change. Constitution of matter, Elements and Compounds, Chemical Affinity, Combining Proportions, Laws of Chemical Combination, Nomenclature, Symbols, Formulæ, Properties of Gases, including influence of variations of temperature and pressure, Diffusion, Atomic and Molecular Weights, Valency Equations. The preparation and properties of the common elements and their more important compounds; examples of Chemical calculations.
   (ii) Practical.—Simple experiments illustrating such Chemical operations as Solution, Evaporation, Crystallisation, Neutralisation, Precipitation, Action of Acids upon Metal Oxides and Salts; behaviour of various bodies with respect to Heat. Approximate determination of equivalent weights. Preparation of common gases, with experiments in illustration of their chief properties. Analytical reactions of the more common Metals and Acid Radicles. Analysis of simple Salts and of easy mixtures. Identification of Substances before the blow-pipe. Experiments illustrating the principles of Gravimetric and Volumetric Analysis.

2. Sound, Light and Heat, together with Weighing and Measuring.
   (i) Theoretical.—Measurement of Length, Area, Volume and Mass. Angular Measurements. Determination of Density of Solids, Liquids, and Gases.
   Sound.—Nature of Sound. Propagation through various media and under varied conditions. Reflection and Refraction, Pitch, Quality and Intensity. Structure of the Ear. Measurement of Frequency. Vibrations of Strings, Rods, Plates, and of Columns of Air. Nodes and Ventral Segments. Overtones. Resonance.
   Light.—The propagation of Light. Measurement of its Velocity. Alteration of Intensity with Distance—Photometry. Reflection and Refraction at Plane and Spherical Surfaces. Formation of Images. Magnifying Power. Structure of the Eye. Vision. Dispersion and Achromatism. Spectroscopy.
   Heat.—Nature of Heat. Expansion of Solids, Liquids, and Gases. Measurement of Temperature. Change of State and other Effects of Heat. Specific and Latent Heat. Calorimetry. Distribution of Heat by Conduction. Convection and Radiation. Relation of Heat to other Forms of Energy.
   (ii) Practical.—To be treated mainly in an experimental manner, the Pupils should make elementary measurements in the Laboratory.

3. Electricity and Magnetism.
   (i) Theoretical.—Electrification by Friction and Induction. Conductors and Insulators. Electrical Attraction and Repulsion. Units of quantity, capacity and potential. Leyden Jars and Condensers. The better known forms of Voltaic Cells. Electromotive force current and resistance. Ohm's Law. Heating Effects. Electric Light. Relation of Electric Currents to Magnetism, Galvanometers, etc. Measurement of resistance. Electro-magnetic Induction. Dynamos, Transformers, etc. Thermoelectricity. Electrolysis. Secondary Cells. Properties of Magnets. Theories of Magnetism. Caramagnetic and Diamagnetic Bodies. Action of Magnets upon each other. Magnetic Moment. The Earth's Magnetism. Electrical and Magnetic Units.
   (ii) Practical.—To be treated mainly in an experimental manner, the Pupils should make elementary measurements in the Laboratory.

4. Geology.
   (i) Theoretical.—Nature and objects of Geology. Chief Minerals entering into the composition of Rocks. Origin and Composition of Rocks. General principle of the Classification of Rocks, Subdivisions of the Stratified Rocks and their Geographical distribution in the British Isles. Geographical distribution of Fossils. Characteristic Fossils of the chief Formations. Distribution of various Economical substances.
   (ii) Practical.—Candidates will be required to give the names of Rocks, Mineral, and three Fossils placed before them.

5. Botany.
   (i) Theoretical.—The Structure of Plants. The Organs of Plants, their Forms and Functions. The Life of Plants. The Chemical Composition of Plants. The Reproduction of Plants. The Classification of Plants. A general knowledge of the Flora of the British Isles, with a special reference to their Economic Products.
   (ii) Practical.—Candidates will be required to identify three plants and to describe them in a scientific manner.

6. Mechanics.
   Treated as far as possible experimentally, and with easy graphical and other calculations. Compounding of forces, accelerations and velocities, the mechanical powers, efficiency, energy, horse-power, work and their measurement, simple harmonic and circular motion, stress, strain, torsion, Young's Modulus, tenacity, etc. Determination of specific gravities "g" and other physical constants.

Commercial Education in the First and Second Grade Secondary Schools (British).

Experience of Secondary schools in England shows that commercial instruction on any systematic line is not very general, but that great attention is devoted to classical and mathematical studies. A prominent writer on the subject of commercial education holds the opinion "that the (English Secondary) schools seem to be still (1901) too much in subjection to the examinations organised by the Universities, and intended to lead, not to business, but to higher classical or mathematical studies." Not a few head masters and business men too consider that specialisation in the direction of preparation for commercial life is quite unnecessary, and find that a good all-round training is of much greater advantage to boys. On the other hand, the head masters of equally important Secondary schools make special provision for commercial teaching in their higher forms. One of the Secondary schools in London gives its boys, when they have reached the upper fifth form, the option of spending about one-half of their time—(*a*) at strictly commercial work, including shorthand, book-keeping, typewriting, and office routine; or (*b*) at subjects required for Civil Service examinations; or (*c*) at the subjects necessary for the Cambridge Local and similar examinations.

University College School, England.—An important English Secondary school of first grade which gives great prominence to the commercial side is the University College School, Gower-street, London. The commercial department in the school was established about four years ago, and placed under the care of a gentleman who, prior to taking charge, had specially studied the best methods of Continental commercial schools. For admission into the commercial department of the school the attainments must be of the standard required for passing one of the following examinations (one modern language *at least* being included among the subjects):—

Cambridge or Oxford Local Senior;
Cambridge or Oxford Local Junior, Honours;
London University Matriculation;
College of Preceptors, First-class.

Intermediate London County Council scholars are admitted to the department if they can show a satisfactory knowledge of a modern language.

The aim of the Department is to prepare—

(1) for the higher branches of Commercial life;
(2) for a University Course in Commerce and Industry.

The ordinary course extends over two years, but a third year class has been added for special advanced studies.

An examination is held at the end of the first year, for admission to the second year's course, and a leaving examination, on the result of which certificates are granted, is conducted by the Technical Education Board of the London County Council at the end of the second year's course.

Mr. Webb writes of this school:—"The result is a highly successful 'first grade' commercial school, in no way inferior to the remainder of the school, recruited by boys of exceptional ability, with a course of instruction every bit as 'cultivating' as that pursued by the others, and yet calculated to fit them for taking responsible positions in the business world, instead of competing for scholarships at Oxford or Cambridge. We need more such schools, if only to fit the ablest boys for a yet higher grade of commercial education."

The comprehensive system of commercial education which exists in the University College School will be manifest to those who study the subjoined syllabus. The work of the institution is well and favourably known in England and Scotland, and stands out very prominently among the best commercial secondary schools of Europe and America, a position due, in a large measure, to the ability and good judgment of the head master of the school, and the master in charge of the commercial department.

UNIVERSITY COLLEGE SCHOOL, LONDON—COMMERCIAL DEPARTMENT.

Curriculum.

I.—Obligatory Subjects.

First year.—English Literature and Composition. History. Geography. Mathematics. Commercial Arithmetic. Book-keeping.

Second year.—English Literature and Composition. Economic History. Geography. Economics. Commercial Science. Commercial Arithmetic. Book-keeping.

Two of the following languages:—French, German, Spanish, Latin.

II.—Optional Subjects.

Higher Mathematics. Physics. Chemistry. Drawing. Shorthand. Typewriting.

Syllabus.

I. Obligatory Subjects.

English Literature and Composition.—Selected works of English Literature. Essay Writing. Précis Writing. Practice in Speaking. Debates on Economic Topics.

History.—

First year.—Modern European History, commencing with the French Revolution.

Second year.—Economic History—(1) Short sketch of the industrial and commercial history of Antiquity. (2) Industrial and commercial history of the Middle Ages, with special reference to England. (3) From the discovery of America up to the invention of the Steam Engine. Special study of the development of England's foreign trade. (4) The Industrial Revolution. The Free-trade Movement. The present organisation of Industry and Commerce.

Geography.—

Mathematical Geography.—Shape, size, and motions of the Earth. The Seasons. Phases, etc., of the Moon. Compass bearings. Cartography—Map projections and map-drawing. Contours, etc.

Physical Geography.—The Earth's crust. Different sorts of rocks. Action produced by wind, rain, ice, rivers, seas. Changes due to human agency. Tides and currents. Winds. Rain. Climate. Distribution of plants, animals, and man.

Economic Geography (General).—Natural conditions. Free-trade. Protective tariffs. Distribution, production, and uses of mineral, vegetable, and animal commodities. Means of transport by land and water. Density of population. Forms of Government. Consuls. Weights and measures. Time. Means of communication by post, telegraph, and telephone.

Economic Geography (Particular).—The British Empire, the countries of Europe, Asia, Africa, and America; noting in each of these—Surface, Climate, Agriculture, Live Stock, etc., Minerals, Government, Manufactures, Canals, Railways, Shipping, Imports and Exports, Protective Tariffs.

The lessons will be illustrated by maps, diagrams, views, specimens of products, etc, etc.

Mathematics

Mathematics (First Year only)—

Algebra : Progressions, Permutations and Combinations, Logarithms, Compound Interest, Annuities, Probability.
Geometry : Ratio and proportion. Solid Geometry. Mensuration.
Trigonometry : Up to and including Solution of Triangles.

Arithmetic—

Rapid computation. Tests for accuracy. Abridged methods of multiplication and division. Rapid decimalisation of money, and the weights and measures. The Metric System. Rapid conversion from the English into the Metric system. The Chain rule.
Percentage, commission, interest, discount, equation of payments, account-current.
Coining and Exchange. Calculation of price of goods c.i.f., etc. Partnership and Companies. Banking operations, International Stock Exchange transactions. Loans, Sinking Funds, Annuities. Frequent practice in Mental Arithmetic.

Economics—

Nature, scope and methods of Economic Science.
Production and Distribution, Labour, Capital, Division of Labour, Values, Free-trade and Protection.
Equilibrium of demand and supply. Short Crops, Famines, Gluts. Money, Credit, Wages.
Relation of State to Labour and Trade.

Commercial Knowledge—

The Manufacturer, Merchant, Trader, Broker, etc. Contracts, Telegraph Codes. Principal, Agent, Partners. Employers' Liability. Companies, Company Law, Syndicates and Trusts. Transit by Land and Water, Navigation Law. Tariffs. Banking, Bills of Exchange and other negotiable instruments. Insurance, Hypothecation. Chamber of Commerce and Consuls. Patents and Trade Marks.

To be illustrated by (*a*) Reference to actual reports on Commerce ; (*b*) Visits to Docks and large Commercial and Industrial Houses, Banks, etc.

Book-keeping.

Modern Languages—

Study of literary works, and works on Travel and Economics.
The Commercial knowledge relative to the foreign country taught in the foreign language. Essays. Commercial Correspondence. Deciphering of foreign handwriting.
(The foreign language to be used as the vehicle of teaching as far as possible.)

II. Optional Subjects.

Higher Mathematics—

Higher Algebra. The Elements of the Calculus.

Physics—

One or more of the following :—Mechanics, Heat and Light, Magnetism and Electricity.

Chemistry—

Practical and Theoretical meaning of Chemical Formulæ and Equations. Numerical calculations. General Principles to be observed in Manufacturing Operations, with special reference to the manufacture of Sulphuric Acid. Detection and removal of impurities, with special reference to the manufacture of pure Nitric Acid. Preparation of some salts largely used in commerce, *e.g.*, Potassium Chlorate. Elementary qualitative analysis of acids.
Metallurgy of Iron, Steel, and Cast Iron in detail. Elementary qualitative analysis of metals.
Preparation of some important Metallic Compounds, *e.g.*, White Lead, Potash, Sodium Carbonate, etc. Elementary qualitative analysis of metals continued.
Manufacture of Coal Gas. Chemical characters of some important organic ompounds, *e.g.*, Soap, Candles, Butter.
Detection of some of the commonest adulterations in articles of food.

Drawing—

Geometrical. Freehand.

Shorthand—

Pitman's or Script.

Typewriting.

A special course of twenty lectures in commercial methods is now (1903) being delivered by Dr. A. Kahn, Master of the Commercial School. The syllabus is as follows :—

Syllabus.

Lecture 1.—Division of Employment in the Commercial Community. Relation of the distributor to the producer. Functions of the factor and broker.
Lecture 2.—Partnership and Companies. The prospectus and balance-sheet of Limited Liability Companies. Private Limited Liability Companies. Companies in Germany and France.
Lectures 3, 4, 5, and 6.—Commercial Contracts. Buying and Selling. Delivery. Methods of quoting. Quality. Direct sales. Sales effected through an intermediary. Sales by Auction. Produce Exchanges. Clearing houses. Trade Associations. Recognised forms of Contract. Arbitration. Speculation.
Lectures 7 and 8.—The Organisation of Various Trades, *e.g.*, the Corn Trade in London ; the Cotton Trade in Liverpool.
Lectures 9 and 10.—The Mechanism and Arithmetic of Exchange. The functions of the banker and bill-broker.
Lectures 11, 12, 13, and 14.—The Machinery and Methods of the Import and Export Trade. The bill of lading and dock warrant. Customs Tariffs : Bonded Warehouses. Freight. Marine Insurance. The theory of general average.
Lectures 15, 16, and 17.—The Stock Exchange. The broker and jobber. Methods of calculation abroad. Arbitrage. The theory of speculation.
Lectures 18, 19, and 20.—Internal Organisation of Commercial Houses. The Theory of Book-keeping. Telegraph codes.

UNIVERSITY COLLEGE SCHOOL.—HIGHER COMMERCIAL DEPARTMENT.

Commercial Crops and Plants and their Products.

I. General considerations. Zones of cultivation. Factors that determine successful and profitable cultivation. Principles of economic crop cultivation.

II. General classification of economic plants and their products (botanical and commercial), with detailed consideration of specific groups.

III. Plants yielding human foods, food stuffs, and food adjuncts :—
(*a*) Bread stuffs and other cereals. (*b*) Starches. (*c*) Pulse. (*d*) Roots and tubers. (*e*) Vegetables and salads. (*f*) Edible fungi, lichens, and seaweed. (*g*) Fruits. (*h*) Nuts. (*i*) Food adjuncts, viz. :— 1. Plants yielding sugar. 2. Plants used in the preparation of beverages. 3. Plants yielding condiments eaten generally with meat. 4. Plants yielding spices added generally to articles containing sugar. 5. Plants yielding flavourers.

IV.

IV. Plants yielding food for live stock :—
(a) Cereals and pulses. (b) Roots and green food. (c) Grasses and clovers. (d) Salt bushes and other plants.

V. Plants yielding oily fruits, seeds, etc., tallows and waxes :—
(a) Essential or volatile oils. (b) Expressed or fixed oils. (c) Vegetable tallows and waxes.

VI. Plant exudations :—
(a) Gums. (b) Resins. (c) Guttas and rubbers.

VII. Plants utilised in textile manufactures.

VIII. Plants yielding dyes.

IX. Plants yielding tans.

X. Fibre yielding plants.

XI. Plants used in paper making.

XII. Plants yielding perfumes.

XIII. Medicinal plants yielding drugs, etc., etc.

XIV. Plants yielding narcotics, stimulants, etc.

XV. Building and furniture timber, and other woods.

XVI. Miscellaneous, joint products of plant and animal.

A collection of illustrative commercial products is used in the class, and an essential part of the course is participation in organised visits to the Economic Museums and Houses at Kew Gardens, the Food Products Museum at Bethnal Green, the Museums of the Royal, Botanical, and Pharmaceutical Societies, the Colonial and Indian Galleries at the Imperial Institute, to the various warehouses at the docks, and to a number of importing, manufacturing, and wholesale houses where varied types of produce and products are handled.

High Schools, Edinburgh and Glasgow.—The High Schools of Edinburgh and Glasgow have each introduced a commercial section into their curriculum.

In the senior department of the Royal High School, Edinburgh, four distinct courses of instruction are provided to meet different capacities and requirements. One of these courses is commercial, and comprises English, French, German, commercial arithmetic, commercial geography, book-keeping, précis writing, shorthand, and commercial correspondence.

In the Boys' High School, Glasgow, a distinct advance has been made in the teaching of commercial subjects. The courses have been reorganised, and a higher commercial department has been added on the lines of the University College School, London. All boys who are entering business or mercantile life, no matter whether they have taken the Latin or non-Latin side, are recommended to complete the advanced commercial course. The ideal course of preparation for a business career is, in the opinion of the head master, one of the three definite courses in a Secondary School (non-Latin, scientific, modern) to the standard of the Sixth Form, boys about the age of 17 years, followed by an advanced commercial course of two years.

CHAPTER LI.

Higher Commercial Education in Great Britain, and Examinations of the London Chamber of Commerce.

[G. H. KNIBBS.]

1. *Introduction.*—In England recently, the fact that neglect of sound commercial education must nationally involve us in serious consequences in international competition has received increasing attention. Owing largely to the influence of the Right Hon. Joseph Chamberlain, it was decided to establish a *Faculty of Commerce* in the University of Birmingham. This was a decided step forward, and is one that is commanding attention. That degree of specialism, which has led to the creation of what are really *commercial universities* in Europe, with thoroughly organised, broadly developed, theoretical and practical courses, has not, however, yet commended itself to the British mind. In the United Kingdom there does not yet exist an institution for commercial education comparable in completeness of equipment, for example, to the Academy of Neuchâtel or the higher schools of commerce of Cologne or Antwerp. There is a degree of concentration and specialisation in Europe which is not to be found in the English system. When thoroughness of training is desired, this has tremendous advantages, and a fact that is becoming more widely recognised.

The European method of training commercial men is analogous to the general system of training medical men. The English system, on the other hand, tends to be academic. It does not lead to that practical acquaintance with business subjects which the continental method does, and it has the same type of defect that a medical course would have if there were no dissection and clinical experience. This, perhaps, states the case strenuously, and would lead to a false impression, unless, at the same time, it is remembered that distinct progress has been made in commercial education.

The University of Birmingham, more, perhaps, than any other University, has beeen influenced by a recognition of the academic dignity of the elements of a liberal commercial education, and, as a consequence, its equipment has endeavoured to respond to modern theoretical as well as practical requirements. In this respect the results are as excellent as is possible in a University of many Faculties, and, for that reason, an account is given of what is claimed for the *Faculty of Commerce* in the University referred to.

2. *The Function of a Faculty of Commerce.*—The general question as to whether it is desirable to insist upon the establishment of Faculties of Commerce must, of course, be considered in relation to the total experience of the world, and not in regard only to the ideals which have expressed themselves in the development of the Birmingham or other English University.

It may be mentioned that the Commissioner here writing, in conversation with the Chancellor of the University (the Right Hon. Joseph Chamberlain), learnt that it was anticipated that the direct work of the University, and its influence in respect to commercial education, would go far to meet the very serious lack which at present exists. For the class of persons which prefer a University career, it is obvious that the system of providing University courses has all the general advantages possessed by liberal education. But, as previously hinted, this system tends to be academic rather than practical; liberal rather than special and thorough.

Much, of course, depends upon the members of the teaching staff, and on the reality of their knowledge of commerce and trade, and of the methods of British and foreign commercial houses. Where that knowledge is thorough, the proper orientation of subjects of instruction becomes easy, and the special commercial equipment of the University tends also to become of greater practical value.

Passing now to the commercial school of the Birmingham University, it may be said that its organisation has been deliberately planned to meet existing conditions in the world of commerce and trade.

3. *Faculty of Commerce, University of Birmingham.*—The calendar of the University of Birmingham gives the underwritten information as to the aim of this "Faculty of Commerce," as it is called. Incidentally it may be remarked that this is one of the many Universities visited by the Commissioners. The calendar expresses the aim and organisation substantially in the following language, viz. :—

The instruction provided by the Faculty of Commerce furnishes a systematic training, extending over a period of three years, and consists of courses of study of two kinds. Some deal with *subjects which are primarily of concern to the future man of business, but which are, nevertheless, capable of being made the instrument of a true education.* Others deal with *subjects which have long been recognised as elements of liberal culture, and yet are peculiarly valuable for those who are to be engaged in commerce and manufacture.* While certain parts of the curriculum are believed to be serviceable for all classes of business men, and are prescribed for all students in the Faculty, other parts are so arranged as to allow considerable freedom of choice, in accordance with the prospects, interests, and aptitudes of the individual students.

Students who have been matriculated in the University, and have acquitted themselves with credit in the requisite class-work and examinations, are entitled to the Degree of *Bachelor of Commerce.* Students may matriculate on passing the Matriculation Examination of the University, or on producing evidence that they have passed one of the examinations which the University accepts in lieu thereof,[1] and the requirements

[1] A schedule of the exempting examinations is given in the Regulations for Matriculation.

requirements in the several subjects of the Matriculation Examination are the same for all Faculties.[1] The number of subjects is also the same ; but the list from which selection can be made by students who propose to matriculate in the Faculty of Commerce is in some respects wider, in others, narrower, than in the case of the other Faculties.

Every candidate in the Faculty of Commerce is required to pass in five subjects before he is allowed the next University examination. These are :—

(1.) *English Language*—Literature and History.
(2 and 3.) *Two other Languages*, from the following, viz. :—French, German, Italian, Spanish, Latin.
(4.) *Mathematics.*
(5.) *One Science* subject, chosen from the following :—Mechanics, Chemistry, Physiography.

Though it is considered very desirable that students should enter upon their work in the Faculty of Commerce with an elementary knowledge of *two* modern foreign languages at present, Latin and *one* modern foreign language are accepted for Matriculation.

The character of the examinations in Italian and Spanish, when these languages are offered, is much the same as for French and German.[2]

Although students will not be allowed the next University examination until they have passed in five subjects, they may be matriculated in the Faculty of Commerce on passing the Matriculation examination in (1) English, (2) Mathematics, (3) one of the prescribed languages, and (4) *either* a Science *or* another language, but the deficiency must be repaired by subsequently passing in the fifth subject.

The Calendar calls attention to the fact that there are other subjects, besides these examined upon at Matriculation, which may advantageously be studied at school by boys looking forward to business pursuits. It states that "skill in *Freehand and Geometrical Drawing* will in many cases be found of practical advantage in after life ; and a knowledge of *Shorthand* will be found especially useful by boys whose careers depend entirely on their own ability and exertions."

Youths who desire a higher commercial education are urged not to leave school before they can pass the Matriculation examination. Even after passing that examination, students may, it is said, be too immature to benefit by a training which calls for the constant exercise of judgment, and accordingly, although no age limit is fixed, each case is determined upon its merits. The Faculty of Commerce reserves the right of postponing the admission of students who, according to its judgment, are insufficiently mature in mind and character to benefit by the instruction. Such students may be advised to spend a preliminary year in a workshop or counting-house, and the same course may be followed in the case of students who look forward to entering businesses in which early practical training is desirable.

4. *Curriculum for the Degree of Bachelor of Commerce.*—The regulations as to the curriculum in Commerce are thus expressed :—"Candidates for this degree are required to have attended the following courses of study, and to have passed the University examination thereon at the end of each of the three years. There will be a *viva voce* examination in foreign languages in each year ; and also in such other subjects in the third, and final, examination as the examiners may determine. Candidates may offer themselves for the whole or any part of the examination in any year. The names of those who pass in each subject will be arranged in three classes, alphabetically in each ; and the subjects taken by each student will be recorded on the degree *testamur*, with the class obtained in each. Only matriculated students will be admitted to University examinations (in which external examiners co-operate with the University staff). The class examinations, to which non-matriculated students will be admitted, will be conducted by the University staff alone, and the certificates will contain no distinction of classes. The content of the several courses will be learnt from the syllabuses which follow the curriculum ; and (in the case of courses in Modern Languages and Science) from those in the announcements of the Faculties of Arts and Science."

The work is as follows :—

First Year.

(1.) Commerce I. Two papers.
(2.) Any two of the following modern languages : French, German, Spanish, Italian. Two papers in each.
(3.) Accounting I. One paper.
(4.) European History since the French Revolution. Two papers.
(5.) *One* of the following : (1) Mathematics, (2) Physics, (3) Chemistry, (4) Logic.
Or *two* of the following : (5) Geography, (6) Elementary Psychology and Logic, (7) British Institutions.

"*Languages.*—The examination in French or German at the end of the first year will be the same as that for the Intermediate Examination in Arts. Students, therefore, who select either of these languages, and are unable, from want of preparation, to benefit by the first University course, will begin with the preliminary course, and will be expected to give a larger proportion of their attention to the language in which they are backward in order to make up the deficiency as rapidly as possible.

"Provision will be made for instruction in Spanish or Italian. Students who wish to select these languages are requested to communicate with the Dean of the Faculty of Commerce a few days before the opening of the Session."

"*Mathematics.*—Either Pure Mathematics, Course I (*i.e.*, Algebra, Trigonometry, Geometry), or "Applied Mathematics, Course I" (*i.e.*, Statics, dynamics, hydrostatics). It is not necessary to specify these in detail.

"*Physics and Chemistry.*—The courses to be taken in these subjects by those students in the Faculty of Commerce who select them will be determined after consultation with the Dean of the Faculty of Commerce, upon consideration of the needs and purposes of the individual students. When the course arranged involves less expenditure of time on the part of the student than Physics I, or Chemistry I, supplementary work in other subjects will be required, and must be planned after consultation with the Professor of Commerce."

Geography.—This is referred to in the syllabuses of the Faculty of Science.
Logic.—The course is shewn in the syllabuses of the Faculty of Arts.
Elementary Psychology and Logic.—The syllabuses of the courses on education shew the work demanded.
It is not necessary to detail the above.
Commerce, Accounting, European History, and British Institutions, are referred to in the syllabuses below.

SECOND

[1] They will be found in the Regulations for Matriculation.

[2] For prepared work, *either* Bersezio, *Il Cane del Cieco* (Richter Davos) *or* Silvio Pellico, *Le Mie Prigioni*, may be offered in Italian, or Cervantes, *The Adventure of the Wooden Horse and Sancho Panza, Governor of Barataria* (Clarendon Press), in Spanish, or any other books of similar length and difficulty.

SECOND YEAR.

(1.) Commerce II. Two papers.
(2.) Languages, as in the first year. Two papers in each.
(3.) Accounting II. One paper.
(4.) Public Finance. One paper.
(5.) Economic Analysis. One paper.
(6.) One of the following:—(1) Mathematics; (2) Physics; (3) Engineering; (4) Metallurgy.

Or two of the following:—(5) Geography, or Geology; (6) Ethics; (7) History and Institutions of France; (8) History and Institutions of Germany; (9) History and Institutions of Spain and Spanish America.

Languages.—Students can in this year select only those languages on which they have passed the examinations of the previous year, or in which they can already shew, to the satisfaction of the Professor of the language, the same proficiency as is demanded at the First University Examination. The work in each language will include *Conversation*, Dictation, Translation at Sight, Composition, and Lectures on the History of Literature. The books read will consist, in the earlier part of the session, of literary masterpieces; in the later part of the session, of typical examples of foreign, commercial, and industrial literature. The object of the course is to enable the student to keep abreast, in future, of commercial industrial changes in other countries by consulting current foreign publications.

Mathematics.—Either Pure Mathematics, Course II (*i.e.*, algebra, trigonometry, geometry, differential and integral calculus), or Applied Mathematics, Courses I or II (*i.e.*, statistics, dynamics, hydrostatics).

Physics, Engineering, Metallurgy.—The courses to be taken in these subjects by those students who select them will be determined after consultation with the Dean of the Faculty of Commerce, upon consideration of the needs and purposes of the individual students.

Geography or Geology are referred to in the syllabuses of the Faculty of Science.

Ethics and Social Philosophy are courses outlined in the syllabuses of the Faculty of Arts.

History, etc., of France, Germany, and Spain.—These courses can only be selected by students who are taking the corresponding language courses, or have reached a proficiency in the corresponding languages equal to that required in the Second University Examination in the Faculty of Commerce.

For Commerce, Accounting, Public Finance, and Economic Analysis, the syllabuses are given hereunder.

THIRD YEAR.

(1.) Commerce III. Two papers.
(2.) Languages, as in the previous years. One paper in each.
(3.) Accounting III. One paper.
(4.) Commercial Laws. One paper.
(5.) Transport. One paper.
(6.) Subjects involving six papers, selected from the following list:—
  (*a*) Technique of Trade. Two papers.
  (*b*) Money, Credit, Banking, and International Exchange. Two papers.
  (*c*) Methods of Statistics. One paper.
  (*d*) Factory Hygiene and Legislation. One paper.
  (*e*) i. Physics
    ii. Chemistry
    iii. Engineering
    iv. Metallurgy
    v. Economic Geology
    vi. Electro-technics
    vii. Brewing
    viii. Mining
  } Two subjects at most from this List.

Students looking forward to a specifically *mercantile* life are recommended to select the courses numbered (*a*) to (*c*) under 6. Those looking forward to a *manufacturing career* are recommended to take (*d*); and after consideration of their capabilities and prospects, they may be wise in making a selection among the courses i to viii under (*e*). The details of this year's work will be announced later.

Languages.—The work in this year will deal with Commercial Correspondence; though, in exceptional cases, with the consent of the Dean of the Faculty, the study of the literature of some particular branch of business in the languages selected (*e.g., on engineering, mining, railway administration, municipal administration*) may be substituted. Students will be allowed to select the course in Commercial Correspondence only in those languages in which they have reached the proficiency demanded at the First University Examination.

Scientific and Technical Subjects in (e).—The courses to be taken in these subjects by those students who select them will be determined after consultation with the Dean of the Faculty of Commerce. The purpose in this, as in the previous years, is to give the future man of business such a knowledge of the processes of manufacture as may be useful to one whose chief interest, nevertheless, is on the commercial side. Most of the courses mentioned under (*e*) are more definitely technical or professional than those in the previous years; but no student will be admitted to a course involving preliminary knowledge unless that knowledge has been previously acquired. The arrangements with the several Professors in the Faculty of Science will be made through the Dean of the Faculty of Commerce.

Factory Hygiene and Legislation.—Particulars of this course will be announced later.

For Commerce, Accounting, Commercial Law, Transport, Technique of Trade, Money and Banking, and Methods of Statistics, see the syllabuses below.

Fees.—The Composition Fee for the whole curriculum will be £21 each year. This includes the Membership Fee of £1 1s.

Matriculation	£2	Second Examination	£3
First Examination	£3	Bachelor of Commerce	£3

Each of the classes in the Faculty of Commerce is open to all persons who are capable of taking advantage of the instruction offered, whether they have matriculated or not; and pass-certificates will be granted to non-matriculated students at the end of each session on the results of the class examinations.

The conditions of admission in the case of non-matriculated students are identical with those for similar students in the Faculties of Science and Arts. They include registration in the Secretary's Office, the payment of a variable membership fee (*e.g.*, for a single course running through the whole session, 10s. 6d.), and the payment of fees for the particular courses selected (given below with the several syllabuses).

But although only students who have been matriculated can become candidates for the degree of Bachelor of Commerce, non-matriculated students can at any time qualify for the degree by passing the Matriculation and other University examinations, without further attendance upon courses already taken by them; *provided that*, before receiving the degree, they have attended all the required courses, and have devoted to study within the University an amount of time equivalent to three continuous years.

5. *Synopses of Commercial Courses, Birmingham University.*—The following will give some idea of the Courses in Commerce. They are quoted *verbatim et literatim* from the Calendar.

COMMERCE AND PUBLIC FINANCE.

COMMERCE.

Courses I and II.

I. First Year: The British Empire, with particular regard to existing circumstances in the colonies and dependencies. Two hours weekly, by arrangement. A number of Special Reports will also be called for from each student, upon topics assigned to him for investigation. Fee, £4 4s.

II. Second Year: The United States, Germany, Russia, France, other European countries, South America, etc. Fee, £4 4s.

These

These courses will set forth the modern development and the present structure and position of industry and trade in the leading countries of the world. This will involve a consideration of geographical position and natural resources on the one side, and, on the other side, of the supply and organisation of capital and labour, and of the state of the mechanical arts; and the course will lead up to a critical account of international commercial relations.

Commercial History and Commercial Geography will be largely introduced; but they will be treated in relation to one another, and in close connection with the discussion of problems of the present.

Course III.

Third Year: Business Policy, in its main principles, as indicated by industrial and commercial experience.

The course will deal with such topics as the following:—

The Location and Laying-out of Works and Offices; Capitalisation; Production on Large and Small Scale; Differentiation and Consolidation of Manufactures; Combinations of Manufacturers or Merchants; Limited Companies, Private and Public—their Advantages and Disadvantages; Factoring and Manufacturing; Machinery—its Financial and Industrial Consequences; Works Management; Relations of Employers and Employed—Methods of Remuneration, Hours of Labour; Markets; Advertising; Negotiation; Relation of Selling Markets; Advertising; Negotiation; Relation of Selling Price to Cost, Fixed Charges; Methods of Sale and Purchase; Credit; Goodwill; and Trade Cycles.

Public Finance.

Second Year. Fee, £1 11s. 6d.

This course will treat of Public Expenditure, Public Revenue, and Public Credit, as illustrated especially in the national, country, and municipal experience of Great Britain. It will discuss the principles and methods of Taxation, and the methods of contracting and extinguishing Debt; and it will include a comparison with foreign systems of raising revenue.

Students will examine the last British Budget, and will read a number of the more important Budget speeches of recent decades.

The course is recommended to students who propose to enter, or are already engaged in, municipal or banking service.

TRANSPORT.

Third Year. Fee, £1 11s. 6d.

The course will give an outline survey of the various means of transportation, with a more particular treatment of railways—their development and organisation. The forces influencing railway rates will be considered, and the attempts of various Governments to control and manage railways will be explained and criticised. Some attention will also be given to ocean freights, as well as to canals and other means of internal communication.

TECHNIQUE OF TRADE.

Third Year. Fee, £4 4s.

This course will deal with the organisation of the great staple markets and commercial institutions at home and abroad, the chief technical terms, and the most important mercantile documents. It will *not* seek to reproduce the minutiæ of counting-house practice.

MONEY AND BANKING.

Third Year. Fee, £1 11s. 6d.

The functions and forms of Money; Credit Instruments and their use; the functions of Banking and the organisation of the English Banking System as compared with those of the United States and Germany; the Money Market; and the phænomena of International Exchange.

STATISTICS.

Third Year. Fee, £1 11s. 6d.

This course is intended to serve as an exposition of the statistical methods most commonly employed rather than as a description of mere results. The chief governmental statistics of Great Britain, dealing with trade and manufactures, will be examined; and an attempt will be made to indicate, after a consideration of the mechanism for securing information employed in each case, the extent to which the results are of value, and the way in which they might be rendered more serviceable.

ECONOMIC ANALYSIS.

Second Year. Fee, £1 11s. 6d.

This course will take a rapid survey of the whole of the wealth-producing and wealth-distributing activity of society. It will seek to disentangle the larger forces at work, to direct attention to the complex relations of cause and effect, and to indicate the general causes and criteria of national prosperity. It will thus supplement the courses on Commerce by (1) emphasising the general considerations only incidentally touched upon therein, and (2) connecting commerce with other sides of national life.

HISTORY.—EUROPEAN HISTORY.

First Year.—Two hours weekly, by arrangement. Fee, £2 12s. 6d.

This course will present the broad outlines of the political and constitutional history of Europe and America, since the French Revolution. Its object is to assist the student to realise the forces which have been at work in shaping the present condition of western society, and to realise the motives (other than those primarily economic) which now influence the policies of contemporary statesmen and parliaments.

BRITISH INSTITUTIONS.

First Year.—Two hours weekly, by arrangement. Fee, £2 12s. 6d.

In this course an account will be given of all the more important parts of the governmental machinery of the British Emqire. First of Great Britain and Ireland, from the Parish Council up through the District, Borough, and County Councils to Parliament itself, together with the Judiciary and the Central Executive Departments,; then of the chief self-governing daughter peoples—Canada, Austrulia, South Africa; then of the Crown Colonies and India; and finally of the Privy Council and other Imperial institutions.

ACCOUNTING.

Course I.—First Year.—Monday, 5·30 to 6·30. Fee, £1 11s. 6d.

Instruction in simple systems of book-keeping, explaining the meaning of Debit and Credit and the principle of Double Entry, and wherein it differs from Single Entry. The course will comprise a description of all usual subsidiary books, leading up to the account-books proper. Such instruction will include an explanation of the Trial Balance, the Balance-sheet, and Trade Account, and the meaning of "Capital" and "Revenue," and other terms used in book-keeping and accounts.

Course I.—A. Wednesday, 9·30 to 10·30, during the Winter Term.

The Professor of Mathematics will give a short course of lectures on the Theory of Compound Interest, Annuities, and Sinking Funds, together with an explanation of the construction and use of Interest, Annuity, Life, and Sinking Fund Tables. Opportunity will also be taken in connection with this course to give some training in rapid arithmetical methods. The course is recommended for Accountants, Surveyors, and Actuaries, but is not obligatory on other students in the Faculty of Commerce.

Course II.

Course II.—Second Year. Fee, £3 3s.

This course will begin with a further explanation of the technique of Accounting. This will include—(1) A description of the various forms of books suitable for different requirements, with an explanation of the sectional balancing of books; (2) An outline of the forms of Books and Accounts adapted to different classes of undertakings, such as Banks, Public Authorities, Gasworks, Shipping Companies, Railways, Tramways, Collieries, Breweries, Manufacturers, Merchants, etc.; (3) A description of the books and forms required in connection with the Share Capital, Mortgages, and Debentures of Joint Stock Companies, and examples of Partnership Accounts.

This will be followed by an explanation of—

(1) Executorship Accounts, including Probate and Residuary Accounts;
(2) Bankruptcy, Liquidation, and Receivership Accounts;
(3) The preparation of Accounts for Income-tax Returns and Appeals.

To this will be added a consideration of the checks and arrangements necessary to ensure accuracy in account-books and the verification of accounts; and a description will be given of Office and Works staff and organisation so far as is necessary to make the methods of book-keeping properly intelligible.

Students may be exempted, with the consent of the Dean of the Faculty, from such parts of this course as are too special or technical for their individual requirements; and a choice of questions will be allowed in the examination.

After this study of the mechanism of accounting, the work of the course will be directed to its higher purpose—to give students a grasp of principles which shall enable them to comprehend the significance of accounts and understand the process by which the earnings and values of industrial properties are computed. This will include an analysis of Receipts, Disbursements, Assets, and Liabilities, in various kinds of industry, and a consideration of Depreciation and Appreciation of Stock and Equipment, Interest, Sinking Funds, Reserve Fund, Reserves, Gross and Net Profit, Working Capital, and Goodwill, with an elementary treatment of Costing and Cost Accounts. A number of published balance-sheets will be studied, and students will be set exercises in their interpretation.

Course III.—Third Year. Fee, £4 4s.

The course will begin with a discussion of Statistical Accounts and of Head Office and Branch Accounts, and a consideration of systems for centralising the Book-keeping of Branches.

But it will be mainly devoted to a consideration of Departmental Book-keeping and Accounts, Stock and Stores Accounts, and advanced Costing and Cost Accounts, suitable for various undertakings.

Attention will be called to the several possible systems of Costing, and the merit and weakness of each; the several circumstances to be borne in mind in various typical businesses when constructing a system; and the necessary limitations of cost accounts.

COMMERCIAL LAW.

Third Year. Fee, £3 3s.

Contracts; Agency; Partnership and Company Law; Bankruptcy; the Law of Cheques and Bills of Exchange; the Law of Patents; the Law of Master and Servant.

SCHOLARSHIPS.

A Scholarship of the value of £30 per annum, given by members of the Dudley and District Chamber of Commerce, will be awarded to candidates from that district who are qualified to enter the Faculty of Commerce in the University, in October, 1902.

6. *Faculty of Commerce, University of Manchester.*—The University of Manchester has established a Faculty of Commerce, conferring the degrees of *Bachelor* and *Master.*

The matriculation conditions are practically identical with those of the University of Birmingham.

Candidates of the Bachelor's degree are required to satisfy the examiners in the following subjects, viz., (i) Political Economy; (ii) Geography; (iii) Modern History; (iv) A modern language; (v) The Organisation of Industry and Commerce; (vi) Accounting; (vii) Commercial; (viii) A special subject as follows: One subject from Group (a), or two subjects from Group (b), and two subjects from Group (c). Candidates who do not select a subject from Group (a) are required to offer one modern language at least from Group (b). These groups are:

Group (a) A Science.

Group (b) A Science; a second Modern Language; an advanced stage of a Modern Language; Currency and Banking.

Group (c) Accountancy; Foreign Trade and Foreign Exchanges; Railway Economics and Transport; the Cotton Industry; Special Period in Economic History; Public Finance; Statistics; Insurance; the Law of Patents, Designs, and Trade Marks; International Law; a Special Subject in Geography; Political Science.

Candidates may present themselves for any one subject or any selection of subjects at once, and a candidate who presents himself in more than one subject may be held to have satisfied the Examiners in any or all of the subjects in which he has offered himself.

Candidates who have passed the final degree examination of this or any other University of the United Kingdom, or who present evidence of University study satisfactory to the Board of Faculty, are to be excused such attendance as the Faculty may determine, and may graduate after two years of study in the subjects for the degree.

The degree of Master of Commerce is to be conferred upon Bachelors of Commerce when of three years' standing from the date of their graduation as Bachelors, subject to the conditions contained in the following paragraph:—

Candidates for the Master's degree are to be required to offer a dissertation on some subject approved by the Faculty, and must also submit to such examination as the Examiners may desire.

Qualifying courses for degrees are arranged at such hours as to make it possible for students engaged in business to graduate in the Faculty, but candidates who have not attended approved courses of study in the University for at least seven hours a week each year for three years are not admitted to the degree without attending courses of study approved by the Board of Faculty for one or more additional years.

The following subjects and hours of attendance shall be required for the examination:—

Political Economy (2 hours a week throughout the session):—

The Economics of Consumption, Production, Exchange, and Distribution.

Geography (2 hours per week):—

Definition and description of geographical conditions and their influence on economic and political development.

Modern History (2 hours per week):—

Outlines of General History from the fall of Napoleon, with special reference to social and economic developments.

Modern

Modern Languages (3 hours per week) :—
(1.) Interpretation of prescribed books with literary and grammatical questions.
(2.) Unseen translation from and into English.
(3.) Composition and commercial correspondence.
(4.) Dictation and conversation.

The Organisation of Industry and Commerce (2 hours per week) :—
A description and analysis of modern industrial and commercial conditions.

Accounting (1 hour a week for two winter terms, but candidates without experience are required to attend for one hour a week for three terms or even for four) :—
The principles and practice of Accounting.

Commercial Law (1 hour per week) :—
The principles of Law applicable to, and the more important cases bearing upon the following subjects, viz. : Principal and Agent ; Partnerships, Limited Companies ; Mercantile Securities ; Guarantees ; Carriage by Land ; Carriage by Sea (Charter Parties and Bills of Lading) ; Policies of Insurance ; Sale of Goods ; Bills of Exchange ; Cheques and Notes ; and Bankruptcy.

Successful candidates in the examinations are in two classes (grades), but the names of candidates who have qualified by examinations for the degree are arranged in alphabetical order, without distinction of classes. Examinations in all subjects are held once a year. No distinction is made in the classes for the Master of Commerce degree.

7. *Higher Commercial Certificates, Manchester University* :—" Higher Commercial Certificates " are awarded in the Manchester University, under the following conditions, viz. :—

(1) The evidence, before commencing the course of attainments of a standard similar to that required for the Matriculation Examination of the University.
(2) The course for the first year, or its equivalent, includes : –
 (a) One, at least of the following languages :—(i) French ; (ii) German ; (iii) Spanish.
 (b) Geography.
 (c) Law.
 (d) A subject in Economics or Commerce.
 (e) An optional subject (to be approved by the Vice-Chancellor of the University) from among the courses of instruction shewn in the University Calendar.
(3) The course for the second year, or its equivalent, will include :—
 (a) At least one of the languages named above.
 (b) Geography.
 (c) Law.
 (d) A subject in Economics or Commerce.
 (e) An optional subject, under the same conditions as in the first year.
(4.) The attendance required in the various subjects is as follows :—
 (a) In a Modern Language, not less than three hours a week.
 (b) In Geography, two hours a week in the first year, and one hour in the second year.
 (c) In Law, not less than one hour a week in one of the two years, and two hours a week in the other.
 (d) In Economics or Commerce not less than one hour a week in one of the two years, and two hours a week in the other.
 (e) In optional subjects, not less than three hours a week.
(5) Candidates may obtain permission to substitute other courses for one or more of those above specified.

8. *Synopses of Subjects—Faculty of Commerce, Manchester University.*—The following synopses of the various courses will give an indication of how the subjects are treated in detail.

POLITICAL ECONOMY.

I. *The Principles of Political Economy.*—(Two hours weekly ; fee, £2 12s. 6d. per course).

Political Economy, the character of its data and the methods by which they are studied ; the extent of economic science and its place among the sciences ; its relation to practice ; the meaning of Economic Law ; the factors in production and their combinations ; labour and natural agents ; Capital, its influence and the conditions of its accumulation ; wants in relation to demand ; varieties of demand ; value in relation to riches ; price, utility, and cost of production ; determinates of ratios of exchange ; the elements of cost ; complex problems of value ; the law of rent ; interest and profits ; causes of the rates of wages ; general theory of the value of money ; the theory of international trade and its relation to the home trade ; the value of foreign bills ; principles of taxation.

II. *Currency and Exchange.*—(Not given.)

III. *Public Finance and Taxation.*—(Fee, £1 11s. 6d.).

The growth of national and local revenue and expenditure. Sources of public revenue. Income from proprietary State rights and State enterprises. Revenue from taxation ; the principles of taxation ; proportional and progressive taxation ; the single tax ; the general property tax ; the income tax ; the inheritance tax ; the taxation of corporations ; indirect taxes ; the incidence of taxation. Revenue from loans ; the management of public debts ; the growth of the National Debt and its influence on industry.

An analysis of public expenditure, national and local.
The Budgetary System :

Throughout reference is made to the financial organisation and the methods of taxation in the British Colonies, in the United States of America, and in the chief European countries.

This class must be attended by candidates for the Bachelor of Commerce, who offer Public Finance as a special subject.

IV. *Political Economy.*—(Two days a week for the session ; fee, £2 12s. 6d.).
 (a) Questions of Economic Theory.
 (b) Statistical Investigation.
 (c) Problems in the Organisation of Industry.

Industry and Commerce.

I. *The Organisation of Industry and Commerce* (considered historically and comparatively).

The lectures are divided into the following two groups, each of which occupy half the session. Either group may be taken alone.

A. *Industrial Organisation* (including the organisation of markets and problems of Labour and Capital in their relation to each other) :—

General laws of industrial development ; the inter-dependence of market phænomena and industrial phænomena ; general laws of development in dealing ; large and small businesses ; Companies and Trusts ; Co-operation.

The chief groups of markets, their history and present constitution ; the Stock Exchange, produce markets (especially the Cotton Market), and markets for manufactures : dealings in futures.

The great industries in different countries, their history and characteristics regarded comparatively and analytically ; Agriculture, Mining, the Iron and Steel Industries, Engineering, the Textile Industries, Miscellaneous Trades, Statistical Methods.

Problems of Distribution ; Trade Unions, their history and influence ; Employers' Associations ; Modern Socialism ; Labour Legislation.

B. *The Organisation of Commerce.*—(Fee, £2 12s. 6d.) :—

Methods of estimating the value of foreign trade. Imports and Exports. Direct and Indirect Exchange. The Balance of Trade. Main factors in the expansion of international trade. Political and Social forces. The growth of Capital and the organisation of the money market. The working of the foreign exchanges. Transport Development : efficiency of marketing ; cost of freight and insurance. Commercial consolidations. The State and the control of the agencies of transport and communication. The modern organisation of commercial intelligence. Tariff policy and commercial expansion. Examination of the development in the foreign trade of the several leading States with the consideration of their tariff policy, special attention being given to the commercial development of the British Empire, France, Germany, and the United States of America.

Both sections of this class must be attended by candidates for the degree of Bachelor of Commerce

II. *The Cotton Industry.*—(A course of four Lectures ; fee, 5s.).

(1) The rise and early progress of the Machine Cotton Industry in Great Britain, the United States, and the European Continent.
(2) Progress of the Industry in Great Britain, the United States, and the European Continent since 1870.
(3) The extension of the Machine Cotton Industry to India, Japan, and China.
(4) The present position and prospects of the Industry in the several competing countries.

III. *Railway Economics.*—(Fee, 12s. 6d. for course of Lectures lasting one term).

The lectures on Railway Economics are arranged to cover a course of instruction extending over two years. Courses I and II are taken in the first year and Courses III and IV in the second year. In each year a set of lectures, mainly descriptive of the present detailed working of railway systems, and including some account of the law relating to railway transport, occupies the first term, and a set of lectures upon the problems of transport regarded more generally analytically, and considered with reference to different countries and the history of transport, occupies the second term.

I Course treats of: The receipt and delivery of goods ; (2) method of dealing with goods ; (3) methods of charging for goods ; (4) methods of dealing with passenger traffic ; and (5) elements of the Law of Carriers.

The II Course deals with : (1) Railway Geography, especially with reference to the United Kingdom ; (2) Railway History ; (3) the Railway systems of different countries.

In III Course are treated : (1) The preparation of goods and passenger accounts ; (2) the fixing of rates and fares ; (3) Law relating to Railway Charges and Liabilities (Railway and Canal Traffic Acts).

The IV Course deals with : (1) Analysis of the business of transport and comparison with other businesses ; (2) railway policy and the policy of states in relation to railways ; (3) the theory of rates ; (4) railway problems.

IV. *Banking and Exchange.*

First year :—Fee : 12s. 6d. for each of the first two terms and 6s. 6d. for the last.

1st Term :—

Currency and Exchange.—Functions of money ; the evolution of modern money : its qualities ; the state and the control of currency ; seigniorage and mint regulations ; circulation and Gresham's Law ; legal tender money ; standard and token money ; credit and commercial money : its dangers ; convertible and inconvertible paper money ; the suspension of cash payments ; the quantity of money ; historical illustrations ; the appreciation of gold ; its significance ; bimetallism . the case for and against ; international money ; the development of credit money ; ideals of monetary development ; the relation of currency and banking.

Money and exchange ; the theory of the foreign exchange ; international indebtedness ; the equation of international demand ; fluctuations in the prices of bills.

2nd Term :—

The Principles and Practice of Banking.—Bank capital : its functions. Deposits : importance and growth. Bank investments and the management of deposits. Deposit of valuables. Banking profits. Advances : cash, credit, and overdrafts. The foreign exchanges and bankers' acceptances. Financing of exports and imports. Banking instruments, notes, and cheques, discount of bills, bills of lading, dock warrants, letters of credit, and other documents. The money market. Bank rate. Commercial crisis.

3rd Term :—

Six lectures on Parliamentary Reports and Acts relative to (1) the Currency ; (2) the Banking system of the United Kingdom.

Second Year.

1st Term :—Fee, 12s. 6d. :—

The Banks and Banking System of the United Kingdom.—B. Banking : its nature and functions. The various classes of banks. Growth of banking in the United Kingdom. The banking system of England. The Bank of England : its relation to the Government, the banks, and the public. Private banks. Joint stock banks. Banking in Scotland and Ireland. The issue of notes in the United Kingdom. Post-office and trustee savings banks. Foreign and Colonial banks. Bill-brokers. The connection between a country bank and its London agent. The inter-dependence of the various parts of the banking system. Bankers' clearing-house system. The gold reserve. The one reserve system. The development of British banking. Branch banks and amalgamations

2nd Term—Fee, 12s. 6d. :—

Foreign and Colonial Banks.—This course deals with the banking systems of leading foreign countries, and of the British Colonies; attention being given also to currency conditions existing in these countries.

3rd Term—Fee, 6s. 6d. :—

Discussion and enquiry class and a seminar class to consider points of special importance and difficulty in currency and banking.

Attendance at the above courses for two hours a week ensures a completion of the subject.

These courses must be attended by candidates for the Bachelor of Commerce who offer Currency and Banking as a special subject.

Economic History.

I. *The Economic History of England from 1327–1503.*—(Fee, £1 11s. 6d. for the course.)

Session 1905–1906 : The Economic History of England from 1603–1760.
Session 1906-1907 : The Economic History of England from 1760–1900.

The course upon one of these periods must be attended by candidates for the Bachelor of Commerce degree who offer a period in Economic History as a special subject.

II. *The History of the English Poor-Law.*—(Fee, £1 11s. 6d. for the course.)

III. *The Organisation of Industry and Commerce.*

In this course the main features in the history of modern industry and commerce are given.

Modern History.

Outlines of General History from 1815, with special reference to social and economic developments. The fee for this course is £2 13s. 6d., and it must be attended by candidates for the degree of Bachelor of Commerce.

Geography.

I. *Matriculation Class.*

For this class a course of lectures per session for men, and also for women, are delivered, the fee for the two courses being £2 12s. 6d. The lectures are as follows :—

1st Course:—

(1.) The agents at work on and beneath the surface of the earth : water; frost; snow; ice; the atmosphere; chemical action in building up and destroying; organic action; the phænomena resulting from earth-heat; volcanoes earthquakes; elevation and depression of land; mountain-making and valley-carving; hot springs.
(2.) The distribution of land and water.

2nd Course:—

The construction of maps; the influence of natural conditions on industry and commerce; the commercial highways of the world; the growth of the British Empire; the chief commercial centres, principal products and trade, etc., of the various colonies and dependencies; the United Kingdom : its population, government, industries, commerce, etc.

II. *Commercial and Political Geography.*—(Fee for the course, £2 12s. 6d.)

The object aimed at in the lectures is to give a description and explanation of the influence of geographical phænomena upon the economic development of the leading industrial nations of the world and of the countries with which they trade. The course is divided into two parts, the first dealing with the general principles involved, and the second with the application of these principles to regional geography. The subjects dealt with in each are as follows :—

A.—*General.*

The geographical conditions determining human settlements and the development of civilisation.

Climate.—The various conditions on which it depends, and the extent to which man has been able to modify its influence.

Vegetation, as determined by climatic and edaphic considerations. The principal economic plants of the world, and the conditions necessary for their growth.

A description of the more important minerals of commercial value, the state in which they are found, the methods by which they are worked, and the uses to which they are put.

The development of communication—physical controls and the modifying influence of human action and invention.

Geographical considerations which affect the distribution and localisation of industry, the growth of towns and industrial communities, and the development of commerce.

The importance of human action on economic development—the influence of race, government, education, etc., on the industrial progress of nations.

B.—*Regional.*

In this part of the course, the principles laid down in the previous part are applied to different regions of the earth. Natural conditions are described in so far as they influence industrial life. An account is given of the agricultural, mining, and manufacturing industries of each, the chief lines of communication, the most important articles of export and import, and the influence of national characteristics on industrial progress.

Special attention is paid to the countries of Central Europe, the United States, the different parts of the British Empire, and those foreign countries with which we have important commercial relations.

There is also a course of lectures given on the Economic Geology of the British Isles as an index to the geology of the world. For the attainment of the degree of Bachelor of Commerce, this course must be attended.

III.—*The Geography of Central Europe*, with special reference to political and economic development 1 hour per week.—(Fee, £1·11s. 6d).

This course must be attended by candidates of the Degree of Bachelor of Commerce, who offer a special subject in Geography.

There is a course in *Political Philosophy*, the fee for which is £1 11s. 6d., and a course in *Commercial Law*, the fee being also £1 11s. 6d. It deals with the following subjects :—

Principal and Agent; Partnership; Company Law; Mercantile Securities and Guarantees.
Carriage by land; carriage by sea (Charter Parties and Bills of Lading); policies of insurance; sale of goods; bills of exchange, cheques, and notes; bankruptcy.

These classes must be attended by candidates for the degree of Bachelor of Commerce.

Accounting

ACCOUNTING.

There are three courses in this subject, which are as follows :—

1st Course: This course, the fee for which is £1 5s., is designed especially for those who have no knowledge of, or whose acquaintance with book-keeping is but slight, and as an introduction to the second and third courses. The following are the details :—

A complete explanation of the theory and practice of Double Entry Book-keeping up to and including the preparation of simple Balance-Sheets and Profit and Loss Accounts ; with some brief remarks on the accounts required for Income-tax purposes.

2nd Course: This course is supplementary to that given above, and is designed also for accountant students and others thoroughly grounded in the principles of double entry. The fee is 12s. 6d. The details are as hereunder :—

Commencing with the Trial Balance, this course comprises fuller explanation of technical accounting, including: Statutory books for companies, consignment accounts ; depreciation, reserves, reserve funds ; the principles governing the division of profits ; the valuation of stocks ; income-tax, etc., etc.

3rd Course: The third course, the fee for which is also 12s. 6d., deals with : Advanced Accounting, including a full consideration of accounts for income-tax returns and appeals, partnership accounts, executorship accounts, cost accounts, etc.

Candidates taking Accounting for the degree of Bachelor of Commerce are required to attend Course II, but for those without experience Course I is also necessary, and attendance at Course III is desirable.

LANGUAGES.

The Language courses are as follows :—

I. *French.*—Translation, Correspondence and Conversation, the fee for which is £3 10s.

II. *German.*—Translation, Correspondence and Conversation, the fee for which being £3 10s.

III. *Spanish.*—Instruction in this language is given in—

(I) *An Elementary Class,* the subjects of which are accidence, translation from English, reading. The translation of easy Spanish commercial letters is taught later on. Spanish conversation is practised from the earliest stages. And in

(II) *An Advanced and Higher Commercial Class,* where instruction is given in higher commercial work, and reading of Spanish modern literature, special attention being given to Conversation and Commercial Correspondence. The fee for each class is £3 10s.

IV. *Arabic.*—Elements of the Grammar of classical Arabic, and reading of simple prose. The phænomena of modern written Arabic, and of spoken dialects, with special reference to Egypt. The reading of texts in the written and spoken languages; reading and writing of Arabic letters. The fee for this course is £2 12s. 6d.

V. *Chinese.*—Instruction is given in this language for at least six hours a week, including practice in writing and pronunciation (Pekingese). And there are two classes, viz., (*a*) for beginners, and (*b*) Advance Course for students who have regularly attended the first year's course or first two years' courses.

The fees are: For six hours per week, for three terms, £5; for three hours, for three terms, £3 10s.

Classes I and II must be attended by candidates who select French and German for the degree of Bachelor of Commerce.

The above gives a fairly full indication of the range of matter treated in the lecture courses.

9. *Commercial Courses in the University of Liverpool.*—A Chair in Economic and Commercial Science was founded in the University of Liverpool, by Sir John T. Brunner, Bart., in 1891. Four courses are given, viz., (1) One on Economic Theory, with two lectures per week during the entire session ; one on descriptive Economics, on Advanced Economics, and on the Economic History of England. For the last three there is only one lecture per week during the entire session. These courses are embraced under the Faculty of Arts.

In what are called the Affiliated Schools of the University is a School of Commerce, which embraces (1) French; (2) German; (3) Spanish; (4) Contemporary history; (5) Commercial geography; (6) Economics; (7) Mathematics; (8) Commercial law; (9) Commercial Bureau, with a Director; and (10) Science.

The organisation of the University is somewhat peculiar for the School of Commerce. There is no Faculty for the subject, but individual parts of the course are to be found under various faculties. For example, commercial law and economic science are embraced in the Faculty of Law, and, as already mentioned, other subjects come under the Faculty of Arts, while mathematics, etc., appear in the Faculty of Science.

It may be pointed out that museums and laboratories for Commercial courses need to be specially fitted, and the existence of a Commercial Bureau, in which typical operations are conducted and typical documents are handled, is necessary for a really thorough course.

10. *Scheme of Commercial Education instituted by the London Chamber of Commerce.*—With a lively sense of the necessity of good commercial education, the London Chamber of Commerce has established a "*Commercial Education Department,*" and now holds a series of examinations for junior commercial education certificates, for senior certificates, and for a teacher's diploma in commercial subjects. It publishes also a series of commercial educational pamphlets, which up to 1905 numbered fourteen. A list of these is given hereafter.

Working in harmony with the London Chamber of Commerce are the Associated Chambers of the United Kingdom, numbering in all about 108. Among these, the following hold examinations as local centres in connection with the London Chambers, viz. :—

Aberdeen, Arbroath, Belfast, Blackburn, Croydon, Derby, Dewsbury, Dundee, Exeter, Inverness, Jersey, Lancaster, Lincoln, Llanally, London, Londonderry, Luton, Newcastle-on-Tyne, Norwich, Portsmouth, Southampton, Swansea, Torquay Tunbridge Wells, Walsall, Worcester, and York.

There

There are two Chambers of Commerce not affiliated with the Association of the Chamber of Commerce of the United Kingdom, but acting as local centres, viz. :—

Caermarthen and Folkestone.

Examinations were held at a large number of local centres other than Chambers of Commerce. These examinations were held at Education offices, Technical Institutes and Schools and Colleges, at Young Men's Christian Association Rooms, Grammar Schools, Science and Art Schools, Church Institutes, Commercial Colleges, Polytechnics, Evening Continuation Schools, Higher Grade Schools, the Xaverian Brothers' School, at Public Offices, at Private Schools, and at the Salvation Army's Headquarters.

The London Chamber of Commerce has a scheme of establishing Committees of Local Centres, either in connection with the Chamber of Commerce or otherwise, and publishes forms of application for colonial and foreign centres.

It may be mentioned that centres have been established at Bombay and Malta (at Valetta), and it is desirable that these centres should be as widely spread over the Empire as possible.

The Chamber of Commerce thus indicates the purport of its effort to establish a definite system of Commercial Examinations :—

The Commercial Education Committee of the London Chamber of Commerce invite the attention of Parents, Students, and all engaged in Educational work, to the Examinations for Commercial Education Certificates, which it annually conducts for the benefit of those wishful of following a commercial career.

The object of these examinations is the promotion of Commercial Education, and thereby the advancement of Commerce :—

i. By encouraging young persons, of either sex, and irrespective of age, to qualify for those positions in the Commercial World which at this moment and for many years past have been far too successfully competed for by foreigners.
ii. By securing greater attention to the teaching of Commercial subjects.
iii. By setting a standard of proficiency to which young persons, wishing to adopt Commerce as a profession, should attain.
iv. By means of practical examinations of a high standard testing the attainments of those who have undergone a course of study in Commercial subjects, and granting, to those having a satisfactory knowledge, Certificates of Proficiency.

The Junior Examination, which is not specially technical, is suited to Pupils in Higher Elementary and Secondary Day Schools, or those employed during the day-time who can only attend Evening Schools and Classes.

The Senior Examination is of a highly technical character, and is suited to youths over 15 years of age, who can devote all their time up to the ages of 18 or 19 to study, or others employed during the day-time who can attend Commercial Classes at Evening Commercial Schools, Polytechnics, and Technical Institutes.

To encourage those intending to enter business life, as well as those engaged in it, to better qualify themselves for their varied occupations :—

i. Upwards of 400 firms in the City of London have promised to give preference in their appointments to applicants holding either the full Junior Commercial Education Certificates or the Senior Certificates issued by the Chamber.
ii. Scholarships, Medals, and Prizes to the value of £250 are offered annually to successful candidates.
iii. The Chamber, through its Employment Department, does its best to secure situations for its Certificate holders. For those holding the full Junior Commercial Education Certificates or the Senior Certificate no charge is made.

The principals of leading Commercial Houses are fully alive to the advantages that must necessarily accrue to their business by engaging qualified employees. They readily recognise the value of the Certificates issued by the London Chamber, regarding them as "Hall Marks of Proficiency," whilst by their possessors they are found to be safe passports to employment and advancement.

The demand for youths holding the full Junior Commercial Education Certificate continues to be in excess of the supply. Possessors of the Chamber's Certificates are not only in a better position to command higher initial salaries, but also possess those qualifications which must necessarily accelerate their advancement in any Commercial House.

Parents and Guardians whose children after leaving school will seek business appointments will act wisely in seeing that they are duly qualified for such positions, and that their knowledge is tested, and evidence of such obtained, by sitting for the Chamber's Examination and possessing its Certificates. To those already in employment the advice is equally applicable, as before many years are past it will be difficult to hold or secure any of the better Commercial Appointments without possessing such credentials of knowledge as are provided by the Certificate of the Chamber.

(Further particulars will be supplied on application to the Secretary, Commercial Education Department, London Chamber of Commerce, Oxford Court, Cannon-street, E.C.)

11. *Syllabus of Examinations for the "Junior Commercial Certificate."* The junior examination is intended to be adapted to pupils in the higher Elementary and Secondary Day Schools, during the last two years of their school life, and also young people attending "Evening Classes in Commercial Subjects" and possibly employed during the day-time.

The subjects are classed under two headings, viz. :—(i) *Obligatory* and (ii) *Optional*; and to obtain the full "*Junior Commercial Education Certificate*," candidates must pass in each obligatory subject, and in at least two subjects in one of the *optional groups*.

Separate certificates are granted for proficiency in the obligatory subjects, and when pupils have received separate certificates for the whole of the obligatory subjects, and at least two in one of the optional groups, the Commercial Education Department of the Chamber of Commerce will, on application, accompanied by the return of separate certificates, issue a "Junior Commercial Education Certificate."

The *obligatory* subjects are as follows :—

(*a*) *English Grammar and Composition*, including handwriting, dictation, orthography, essay, and analysis ;
(*b*) *Arithmetic*, including thorough familiarity with arithmetical theory and practice, and particularly a knowledge of the metric system, mental arithmetic and tots.
(*c*) *A Modern Foreign Language*, comprising conversation, translation, dictation, and composition.
(*d*) *Commercial Geography*, including the physical, political, commercial, and industrial geography of the British Isles, Colonies and Dependencies.
(*e*) *Commercial History and the Elements of Political Economy.*—Commercial history, including that of the British Isles, Colonies and Dependencies. Political Economy, its aim—the production and distribution of wealth, exchanges, money, credit, saving, luxury, application of political economy to financial legislation.

The *optional* subjects are as follows :—

Group (A) : *Mercantile* —

(i) Commercial Arithmetic ; (ii) Book-keeping ; (iii) Advanced Drawing : Freehand, Model, Designing, Mechanical, Geometrical or Perspective ; (iv) Shorthand or Stenotypy ; (v) Typewriting

Group

Group (B) *Linguistic.*—
(i) French; (ii) German; (iii) Spanish; (iv) Portuguese; (v) Russian; (vi) Italian; (vii) Dutch.
Group (C) *Mathematical.*—
(i) Algebra; (ii) Euclid or Geometry; (iii) Trigonometry.
Group (D) *Scientific.*—
(i) Chemistry; (ii) Sound, Light, and Heat; (iii) Electricity and Magnetism; (iv) Botany. (It may be mentioned that practical work is required.)

12. *Syllabus of Examination for the "Senior Commercial Certificate."* The Senior Examination of the London Chamber of Commerce is intended for youths over 15 years of age, who are able to devote the whole of their time up to the age of 18 or 19 to study, and also for those who can attend technical colleges and evening classes, but may be employed during the day.

Candidates are required to pass in each obligatory subject and in at least two optional subjects. Separate certificates are issued which may be ultimately substituted for the full certificate under conditions exactly similar to the previous case.

The *obligatory* subjects are as follows :—
(*a*) English.
(*b*) Foreign (including Oriental) Languages. (Any two preferably, including one other than French or German.)
(*c*) Mathematics.
(*d*) Commercial History and Geography.
(*e*) Elements of Political Economy.

The *optional* subjects are as follows :—
(i) Mathematics, including the compulsory portion treated more fully, and in addition to *Trigonometry.*
(ii) Methods and Machinery of Business :—
(1) *Insurance*—(*a*) Fire and Life.
(*b*) Marine.
(2) *Exchange*—(*a*) The Stock Exchange.
(*b*) Foreign Exchanges.
(iii) Banking and Currency.
(iv) Commercial and Industrial Law.
(v) Book-keeping and Accountancy.
(vi) Chemistry.
(vii) Drawing.
(viii) Shorthand or Stenotypy.
(ix) Typewriting.

13. *The London Chamber of Commerce Teachers' Diploma.*—During this year will be held the first examination for the *Teachers' Diploma* of the London Chamber of Commerce. The general part of the examination is the same as for the Senior candidates, but there are additional questions for those who desire the Diploma; and, moreover, the candidates are expected to pass in a higher grade. Further than this, they will be required also to satisfy the Examining Committee that they are qualified to teach the subjects stated in the Diploma.

14. *Special Prizes of the Textile Trades' Section.*—With a view to the encouragement of the employees in textile houses to continue their education after entering business, and thereby to become fitted for more responsible positions later in life, the members of the textile trade section of the London Chamber of Commerce offer special prizes on the following conditions, viz. :—
(i) Competitors must have been employed at least six months in either the London Wholesale or Retail Drapery or Hosiery Trades as Assistants.
(ii) Candidate's age for entering the Junior Examination must not exceed 21 years.; for the Senior Examination there is no age limit.

The subjects of examination are as follows :—

I. *For the Junior Examination* :—
(i) English Grammar and Composition—including hand-writing, dictation, orthography, essay, and analysis.
(ii) Arithmetic—including mental arithmetic, tots, and a knowledge of the metric system.
(iii) Book-keeping.
(iv) One modern foreign language, either French or German, comprising translation, dictation, composition, and conversation.

II. *For the Senior Examination* they are :—
(i) English.
(ii) Mathematics (obligatory).
(iii) Book-keeping.
(iv) A modern foreign language, either French or German, comprising translation, dictation, composition and conversation.

15. *Details in the Junior Course.*—The following details will give an adequate conception of the grade of work expected of the candidates. The obligatory work has been sufficiently specified :—

OPTIONAL SUBJECTS.

GROUP A.—MERCANTILE.

1. *Commercial Arithmetic.*—A general knowledge of Foreign Weights and Measures, Currencies and Exchanges is required, with approximations.
2. *Book-keeping.*—General principles of Book-keeping by double entry, including keeping of ledger and subsidiary books. Knowledge of commercial terms.
3. *Drawing.*—Freehand, or Model, or Designing, or Mechanical, or Geometrical, or Perspective.

Mechanical Drawing to include elevations, plans, and sections of simple solids or groups of solids. Isometric projection (not using Isometric scales) of simple rectangular solids. Making pencil drawings from freehand dimensioned sketches, full size, with two or more views, of common machine and constructional parts involving use of rivets, screw threads, bolts and nuts, flanges and cotters, and of elementary details of engines.

Geometrical Drawing to include construction of simple geometrical figures to test accuracy in drawing and use of instruments. Construction and use of scales. Construction and measurements of angles, division of lines, construction of triangles, and other simple plane figures. Problems on areas. Circles and tangents. Projection of points, lines, planes, figures, and simple solids, with elementary sections and developments. Planes and traces of planes]

4.

4. *Shorthand or Stenotypy.*
I. Shorthand.—Writing in Shorthand (any system) from passages dictated at the rate of seventy and eighty words per minute.
Transcription of the Shorthand.
Spelling, punctuation, and neatness of writing in transcription will be taken into account in judging of the candidates' work.
II. Stenotypy.—Writing in Stenotype from passages dictated at the rate of 70 and 80 words per minute. Transcription of the Stenotype.
Spelling, punctuation, and neatness of writing in transcription will be taken into account in judging of the candidates' work.

5. *Typewriting.*—Copying in correct form commercial letters and tabular statements from manuscript copy.
Special attention must be paid to accuracy, correct spelling, syllabication and punctuation, and general intelligence. Candidates will be allowed to use any make of machine they choose. Those in a position to bring their own machines are recommended to do so.

Group B.—Linguistic.

French, German, Spanish, Portuguese, Russian, Italian, Dutch—Translation from and into English, Dictation, Grammar, Conversation, Composition.
Candidates must pass in Conversation as well as in the written portion of a language in order to obtain a Certificate.
Note.—In languages other than those using the Roman letters, candidates must shew a knowledge of the *written characters* by taking down a passage dictated and by translating a fac-simile letter in the same.

Group C.—Mathematical.

1. *Algebra.*—Up to Quadratic Equations inclusive, together with easy examples on Indices, Ratio, Proportion, Variation and the Progressions, and the Elementary Theory of Logarithms.

2. *Euclid or Geometry.*
I. Euclid.
Books I, II, III and IV, and the first 19 propositions of Book VI, together with easy problems thereon, or
II. Geometry.
I. Theoretical.—The substance of the theorems contained in Euclid.
Book I.—Propositions 4-6, 8, 13-16, 18, 19, 26-30, 32 41, 43, 47, 49.
Book III.—Propositions 3, 14-16, 18-22, 31, 32, 35-37.
Book VI.—Propositions 1-8, 19, 20, 33, together with propositions A and D.
Questions will also be set on the theorems, and easy deductions from them.
Euclid's proofs will not be insisted upon, and the use of any hypothetical construction will be allowed, both in the proofs of the above and in the questions thereon.
II. Practical: A few questions will also be set, involving the use of set squares, scale and protractor, compass and dividers, as applied to.
i. *Easy* problems on the construction of triangles and polygons, the describing of circles fulfilling special conditions, and the drawing of tangents to circles.
ii. Construction of scales and graphs, the geometrical methods of performing such operations as multiplication, division, and the solving of equations.

3. *Trigonometry.*—Up to and including the Solutions of Triangles, the use of Logarithmic Tables, and easy examples in Mensuration.

Group D.—Scientific.

1. *Chemistry.*
I. Theoretical—
The laws of combination. The gas laws treated simply. Outline of the atomic theory. General methods of determining combining weights, atomic weights and molecular weights. The periodic law. Valency of elements.
Some knowledge of the methods employed for the exact determination of the combining weights of such elements as Hydrogen, Oxygen, Carbon, Silver, Chlorine. Formulæ and equations and their use in simple calculations of quantities by weight and volume. Outline of modern theories of the nature of aqueous solutions and of the phænomena of osmos and electrolysis treated in a general manner without mathematics. Classification of the elements with reference to their properties, their oxides and hydrides and their electrical relations. A general knowledge of the application of electricity to the preparation of elements and compounds.
The principal processes employed in the preparation and isolation of the elements Hydrogen, Oxygen, Nitrogen, Carbon, Sulphur, Phosphorus, Arsenic, Chlorine, Bromine, Iodine, Fluorine, Boron, Silicon—The chief sources of these elements—Their most important properties. Allotropy as illustrated by Oxygen, Carbon, Sulphur, Phosphorus.
A general knowledge of the preparation and characters of the chief compounds of the above elements, such as Water, Ammonia, Nitric Acid and the Oxides of Nitrogen, the Oxides of Sulphur, Sulphuric Acid, the Oxides of Carbon, Phosphoric Acid, the Hydrides of Chlorine, Bromine, Iodine, and Fluorine, Borax, and Boracic Acid, Silica, and the most common Silicates.
An elementary knowledge of such typical carbon compounds as Methane, Ethylene, Acetylene, Alcohol, Cellulose, Starch, Sugar.
A general knowledge of the metals Potassium, Sodium, Iron, Lead, Tin, Zinc, Aluminium, Copper, Calcium, Magnesium, Mercury—Their occurrence—The character of their chief oxides—The isolation of these metals by simple processes from their oxides or sulphides or chlorides.
II. Practical—
The identification of simple substances and of the constituents of mixtures containing not more than two salts or two simple substances. Examination of the effect of heat upon single salts or simple substances, and the identification of the products of the action. Simple exercises involving the collection of gases, distillation, crystallisation, measuring volumes and weighing.
Problems in acidimetry and alkalimetry and simple estimations with standardised solutions of Potassium, Permanganate, Silver Nitrate, Iodine.

2. *Sound, Light, and Heat* (together with Weighing and Measuring).
I. Theoretical—
1. Weighing and Measuring—Simple theory of balance. Specific gravity of solids, powders, and liquids. Volume measurement. Hydrometers. Atmospheric Pressure. Boyle's Law. Siphon. Pumps.
2. Sound—Mode of Propagation of sound waves. Amplitude. Frequency and wave length. Velocity of sound in different media. Siren. Organ. Pipes, Pitch, intensity and quality. Simple resonance. Vibration of strings and rods.
3. Light—Formation of Shadows. Photometry. Pinhole Camera. Laws of Reflection. Reflection at Plane Mirror. Multiple Reflection. Graphical formation of images by concave and convex spherical mirrors and lenses. Laws of Refraction. Total Reflection. Refraction through a plate. Apparent thickness of a plate. Refraction through a prism. Spectroscopy. Calculation of images formed by convex and concave lenses. Dispersion. Achromatism. Colour due to absorption. Magnifying Glass, Telescopes Microscope.
4. Heat—Temperature. Thermometry. Simple Expansion of Solids, Liquids, and Gases. Specific Heat. Calorimetry. Fusion. Evaporation. Boiling. Effect of pressure on change of state. Saturated Vapour. Dew Point. Latent Heat. Conduction. Convection. Radiation. Mechanical equivalent of heat and its measurement,

II. Practical—

Use of Vernier. Measurement of linear dimensions by micrometer gauge. Reading of Barometer. Proof of Boyle's Law. Specific gravities and volume determination by balance method. Time of oscillation of simple pendulum. Measurement of tuning-fork by siren and by resonance. Proof of laws of vibration of strings. Photometers. Measurement of the angle of a prism, and determination of refractive index of sodium light. Focal length of concave mirror and convex lens. Arrangement of lenses to form simple optical instruments. Tracing path of ray through glass cube and deduction of refractive index. Expansion of Metal Bars. Apparent expansion of liquids and gases. Melting Points of Solids. Boiling Points of Liquids. Vapour Pressure. Dew Point. Specific Heat of Solids. Latent Heat of Fusion of Ice. Latent Heat of Steam.

3. *Magnetism and Electricity :—*

I. Theoretical—

1. *Magnetism.*—Magnetic Attraction and Repulsion. Pole. Axis. Lines of Force. Consequent Pole.

16. *Details of the Senior Course.*—The expanded synopses for the Senior Course are as hereunder:—

1.—OBLIGATORY SUBJECTS.

The *extent* of the knowledge required of the student in these subjects, will be gathered from the following syllabus :—

English.

1. *Composition and Précis.*—The candidate will be expected to write a short essay on some generally known subject, paying special attention to grammar and style ; also a précis in the form of a narrative of the contents of one or of a number of letters or documents dealing with a particular subject, so that anyone reading the précis may be put into possession in the smallest space of time of the main features of the subject to which the documents refer.
2. *Literature, History and Geography.*—The questions will be set with the object of testing the candidate's knowledge of :
   (*a*) English literature generally.
   (*b*) English history with special reference to the growth of the British Constitution.
   (*c*) Geography with special reference to the British Empire.

Foreign including Oriental Languages.

1. Translations from and into the foreign languages with grammatical questions.
2. A short essay in the foreign languages.
3. Questions on technical terms of commerce—translation of an English commercial letter into the foreign languages, or composition of a commercial letter in the foreign languages from notes.
4. Dictation in the foreign languages.
5. The candidates' ability to express themselves with ease in a colloquial manner will be tested by conversation in the foreign languages.

Candidates must pass in conversation as well as in the written portion of a language in order to obtain a certificate.

Note.—In languages other than those using the Roman letters, candidates must shew a knowledge of the *written characters* by taking down a passage dictated and by translating a fac-simile letter in the same.

Mathematics.

1. *Arithmetic.*—Knowledge of the principles of whole numbers and of vulgar and decimal fractions, and facility in their use both for accurate and approximate computation, including applications of arithmetic, such as percentage, proportion, interest, discount, stocks, exchange—areas and volumes of rectangular figures and other ordinary subjects of arithmetical calculation, together with a knowledge of the metrical system of weights and measures—mental arithmetic.
2. *Algebra.*—Knowledge of the mode of expressing the principles of arithmetic by means of algebraical symbols, with the laws of combination of such symbols. Facility in the manipulation of algebraical expressions, including rational fractions and surds. The solution of problems producing equations of the first and second degree, including those with more than one unknown quantity. The meaning and use of indices, and their application as logarithms with facility in the use of tables of logarithms. Arithmetical, geometrical, and harmonical progressions.
3. *Geometry.*—Euclid, books I., II., III., IV., or the substance thereof. Deductions from the propositions. Proofs other than Euclid's will be accepted, but Euclid's sequence must be observed.

Commercial History and Geography.

1. Phœnician and Ancient Greek and Roman commerce and colonisation. Mediæval Commerce. The Hansa and the Baltic trade. The Staple system. The rise of the Merchant Adventurers. The discovery and early exploration of America. The discovery of the sea-way to India. The search for the north-west and north-east passages to India. The Portuguese, Dutch, and English in the East. The Mercantilists, the balance of Trade. Chartered Companies Regulated and Joint Stock Companies. Early Free-trade measures. Commercial Treaties. Physiocrats. Adam Smith. Free-trade. The industrial and commercial revolution at the end of the 18th and the beginning of the 19th Century, and its effects both in the United Kingdom and on the Continent of Europe.
2. Emigration to America and migration in America. Grain cultivation and transport in the United States, Canada, and the Argentine Republic. Industrial and commercial development during the 19th century in the United States, Canada, Australasia, Egypt, British Tropical Africa, British South Africa, India, Ceylon, Japan, and China.

The influence of geographical conditions on the commercial history of all the countries named. This implies an intelligent study of the physical features of the different countries, more particularly in relation to (*a*) their effects on climate and agricultural production, and (*b*) the easiest lines of inland communication, whether by water, road, or rail ; also the study of other causes affecting climate, and production so far as that depends on climate ; the situation of the most important economic minerals and the natural facilities for or obstacles to their economic working ; the effects of all these circumstances on the distribution of population, including the aggregation of population in large towns ; the various circumstances which at different times have given different degrees of importance to different commodities or classes of commodities, and the situation of the different regions producing, and the most important markets for the most valuable commodities, and the routes connecting these, at different times.

Note.—The paper will be set in two sections and certificates will be granted, until 1905, to Candidates passing in one section, who have previously passed the Chamber's Senior Examination in the other section. Candidates who have not previously been examined in either portion of this subject will be required to take both sections as one subject for which certificates will be granted.

Elements of Political Economy.

1. The scope and Methods of Economic Science.
2. Definitions : Wealth ; value ; exchange ; utility ; capital ; market ; supply and demand.
3. Production : Its aim and agents—large and small production.
4. Labour ; Efficiency ; organisation ; division of labour ; population ; effects of machinery.
5. Capital : Nature and functions ; law of increase ; aggregation of capital ; joint stock system.
6. Land and its efficiency : Law of diminishing returns ; law of increasing returns.
7. Theory of value : Market and normal value ; fluctuations.
8. Distribution of Wealth : Principles determining rent, profits, interest, and wages.
9. Combinations of labour and capital : Trade unions, co-operation, trusts and monopolies.
10. State and municipal production and regulation of industry : Transit—roads, railways, canals.
11. Money and credit : Their forms and services ; credit fluctuations and crises.
12. Foreign Trade : Condition, nature and effects : Restrictions on international trading and results.
13. Theory of foreign exchanges and their modes of operation.
14. Principles of Taxation. Public Loans.

2.—

2.—OPTIONAL SUBJECTS.

Mathematics.

The preceding syllabus (under obligatory subjects) and in addition :—

1. *Algebra.*—The meaning of ratio, proportion, and variation, and propositions relating thereunto permutation and combination, and their application to the theory of probability—the binomial theorem.
   Annuities and compound interest.
   Indeterminate equations of the first degree, with graphical representations of their solutions.
   The use of the methods of mathematical induction and indeterminate coefficients, with their application to the summation of series.
   The exponental and logarithmic series, with the theory of proportional parts in logarithms.
2. *Geometry.*—Euclid, Books VI, XI (1-21), or the substance thereof, and the definitions of Book V. Deductions from the propositions (proofs other than Euclid's will be accepted, but Euclid's sequence must be observed). The application of arithmetic to geometry, including the computation of the areas of rectilinear figures, and the volumes of the simpler solids such as the rectangular parallopiped, the prisms, the wedge, the pyramid, and the prismoid. The simpler geometrical properties of the sphere, the right circular cone, and the cylinder and the plane sections thereof.
3. *Trigonometry.*—The sexagesimal and circular measures of angles. The use of the signs + and — to indicate direction of measurement. The trigonometrical functions. The trigonometrical functions of the sum and difference of two angles, and also of multiple and sub-multiple angles. The properties of triangles and of the circles related to a triangle. The properties of quadrilaterals. The solution of triangles, including the use of tables of logarithms for this purpose. The area and perimeter of regular polygons and of the circle. The sums of sines and cosines of angles in arithmetical progression.

Methods and Machinery of Business.

I.—Insurance :—

(*a*) *Fire and Life Insurance :—*

1. Compound Interest. Mortality Tables. Calculation of Life Assurance Premiums
2. Valuation. Sources of Surplus. Allotment of Bonuses.
3. Description of Life Assurance Policies. Policy Conditions. Health and Occupations of Policy-holders. Assignment of Policies.
4. Official Returns of Life Offices—Insurance Book-keeping : Life, Fire, Casualty.
5. Fire Risks. Nature of Sickness, Accident, and Miscellaneous Policies. Settlement of Claims : Fire and Casualty.

(*b*) *Marine Insurance.*—Nature and formation of the Contract, parties thereto and subject matter of Insurance. Insurable interest. Different kinds of policies. Course of business. Insurance agents. Warranties and representations, Duration of the risk, Deviation and change of voyage, Concealment and misrepresentation. Losses under policy. Particular average and total loss. Particular charges. General average. Subrogation. Return of Premium.

II.—Exchange :—

(*c*) *The Stock Exchange.*—Stock Exchange and its Machinery. Constitution and rules. Brokers and Jobbers. The Markets. The contract. Contango and backwardation. Settling, options, script. Bull and Bear. Bonus, coupons, dividend. The public funds.

(*d*) *Foreign Exchanges.*—Machinery of Exchange. Negotiable instruments. Bills of Exchange and Cheques. Indian and Foreign Bills. Acceptance for honour, negotiation, maturity, protest, re-exchange. Stamps required. Inland and Foreign Exchanges. Arbitration of Exchange. Rate of Exchange.

Note.—A full Certificate in the Methods and Machinery of Business will be granted for students taking any three of the four above sections *a*, *b*, *c*, or *d*. Partial Certificates will also be given to students taking only one or more of the Sections separately.

Banking and Currency.

1. The functions and attributes of money. Various systems of legal tender. The monetary standard. Standard and token coins.
2. The regulation of the currency. Note issues.
3. The history of banking in England. The restriction of cash payments and the resumption. The Bank Acts.
4. The structure of the English banking system. The Reserve. The clearing house.
5. The Money Market. Bank rate and market rate. The Bank return. The "Money Article." Bankers and borrowers. Bank balance-sheets.
6. The relation between money, credit, and prices—The effect of the gold discoveries—Financial Crises—The function and limits of speculation—The Stock Exchange.
7. The foreign exchanges—The method by which the country's foreign and colonial trade (import and export) is financed—Financial centres.

Commercial and Industrial Law—

1. History of Commercial Law in England.
2. Contract : Nature of, generally—Elements common to all contracts :—

(i.) Consideration : Formalities required. Capacity to contract.
(ii.) Effect of mistake, misrepresentation, and fraud.
(iii.) Legality of object : Wagering contracts.
(iv.) Assignment of the contract : Negotiability and bills of exchange.
(v. Discharge of the contract.

Attention must be directed to the following special contracts :—

(i.) Sale of goods.
(ii.) Contract on the Stock Exchange.
(iii.) Contract of affreightment : Charter party and bills of lading.
(iv.) Marine insurance : General and particular average.
(v.) Bills of exchange and cheques.
(vi) Agency.

3. Partnership : Nature of, rights of, and duties of partners. Dissolution.
4. Companies : Their formation and powers. Winding up.
5. Bankruptcy and Bills of Sale.
6. The Courts, Arbitration and Awards.

Book-keeping and Accountancy—

1. *Its principles—*
   (i.) *Single entry.*—Its meaning. The books used. Its incompleteness.
   (ii.) *Double entry.*—Its theory. Scientific methods. Adaptability to all classes of commercial transactions. How superior to single entry.
2. *The books employed.*—The uses of the several varieties of Cash Books—Sales Books—Purchases Books—Journals—Ledgers—Subsidiary Books—Special Books used in particular businesses. The "Columnar System." The "Sectional System" of self-balancing ledgers.
3. *The terms used.*—The meaning and nature of the terms employed, such as "Capital"—"Loans"—"Debentures"—"Mortgages"—"Overdraft"—"Creditors"—"Personal and Impersonal or Nominal Accounts"—"Bills payable"—"Bills receivable"—"Discounts"—"Interest"—"Liabilities"—"Assets"—"Debtors"—"Stocks"—"Profit and Loss"—"Shares (Ordinary, Preference, Deferred)"—"Rents"—"Royalties"—"Leases"—"Premiums"—"Depreciation"—"Sinking Funds"—"Provisions"—"Plant"—"Fixed Charges"—"Tillages" "Crops"—"Consignments"—"Investments"—"Reserve Funds," etc.

4.

4. *The balancing of books.*—Methods of balancing books at stated periods. The preparation of Trading Accounts, Profit and Loss Accounts, and Balance Sheets.
5. *The variations in particular businesses.*—The books required ; the methods of keeping them, and the form of the presentation of accounts in different enterprises, such as shopkeepers, merchants, manufacturers, railway and canal companies, gas and water companies, municipal corporations, county councils, insurance (life, fire, marine, etc.) companies, shipowners, brokers, joint stock companies, etc., bankers, etc.

Chemistry—

I.—*Theoretical* :—

1.—The Laws of Combination. Outline of molecular-atomic theory. Avogadro's Hypothesis and its application to the fixing of molecular weights. Fixing molecular weights of dissolved solids and the laws on which the determinations are based. The Periodic Law.
2. Combining weights and their determination by simple methods, some knowledge of the exact methods in the cases of hydrogen, oxygen, carbon, silver, chlorine.
3. Symbols and formulæ and their application to simple calculations. The preparation, by chief process only, of Oxygen, Hydrogen, Nitrogen, Carbon—Their characteristic properties—Allotropy as illustrated by Oxygen and Carbon. The oxides and hydrides of Carbon and Nitrogen with an elementary knowledge of such important compounds as Nitric Acid, Amonia, the Carbonates, Cellulose, Alcohol, Starch, Sugar, and of such phenomena as flame diffusion, etc.
4. An elementary knowledge of the preparation and general characters of the following :—
5. Chlorine, Hydrogen, Chloride, and the chief chlorides—the source preparation and general characters of Bromine, Iodine and Fluorine and of their hydrides.
6. Sulphur, Phosphorus, Silicon, their occurrence, isolation, and leading characteristics, also a knowledge of the characters of their oxides, and hydrides, and of Sulphuric Acid, Phosphoric Acid, Silica, and the chief silicates, *e.g.*, Felspar, Granite, and Clay.
7. A *general* knowledge of the metals Sodium, Potassium, Iron, Lead, Tin, Zinc, Copper, Mercury, Magnesium, Calcium, including their occurrence, the character of their chief oxides and their isolation from their oxides or chlorides by simple processes. Classification of the Elements by reference to their properties and those of their oxides and hydrides, and to their electrical relations.
8. Electrolysis and the application of electricity in preparing elements of compounds.

II.—Practical :—

1. The preparation of metals, oxides and salts, by simple methods (including collecting gases, distillation, crystallisation, etc.), and in approximately predetermined quantities (using equations). Finding the combining weights of elements by simple methods, *e.g.*, the hydrogen liberated metals—The reduction of oxides by hydrogen—Measuring the amount of silver which combines with a given amount of chlorine, or *vice versa*, gravimetrically and volumetrically.
2. Problems in acidimetry and alkalimetry and simple estimations, with standard solutions of potassium permanganate, silver and iodine.

Drawing.

The candidates may take up one of the following sections or groups :—

1. Freehand Drawing, Model Drawing, Shading in chalk or sepia, and drawing from memory, to test powers of observation.
2. Plane and Solid Geometry.—Exercises involving geometrical construction and measurement of lines, angles, plane figures including regular polygons and the ellipse, propositions relating to the areas of plane figures, and to circles and tangents. Construction of simple cycloidal curves and of spirals and helix. Simple exercises in geometrical loci. Points, lines and planes and their traces. Projection of plane incline figures. Plans and elevations of solids including cylinder, cone and sphere. Alteration of ground line. Sections with simple interpenetrations and developments. Representation of planes by scales of slope. Conventional isometric projection. (N.B.—The exercises will be set so as to involve accurate measurements).
3. Perspective.
4. Machine construction.—Making working drawings in pencil, from freehand dimensioned sketches full size or to scale, with two or more views and sections of common machine and constructional parts, and of simple details of engines, machine tools, constructional iron work and electrical machines. (Candidates will be required to know the forms and sizes of such simple parts as rivets, screw threads, bolts and nuts, keys and cotters.)
5. Building Construction.—Making freehand sketches approximately to scale of such parts of joints of woodwork, bonds of brickwork, and other details of simple buildings, and of common types of construction as with foundations, floors, doors, windows, and roofs. Making working drawings in pencil of the same, and other common parts of building construction from sketches supplied. A knowledge of the various uses and properties of the different materials with elementary notions of their strength ; of the forms of common details, and powers of neat and accurate draughtsmanship will be expected.
6. Original Decorative Design and knowledge of styles of ornament.

Shorthand or Stenotypy.—

I.—*Shorthand.*

1. Writing in shorthand from a passage dictated (any system) at the rate of 120 words per minute for a period of ten minutes.
2. Writing in shorthand from a business letter of general commercial phraseology, dictated at the rate of 110 words per minute, for a period of five minutes.
3. Transcription of both of the above.
4. Spelling, punctuation, neatness of writing in transcription, proper arrangement into paragraphs, and general business-like appearance to be taken into account in judging of the candidate's performance.

II.—*Stenotypy.*

1. Writing in stenotype from a passage at the rate of 120 words per minute for a period of ten minutes.
2. Writing in stenotype from a business letter of general commercial phraseology, dictated at the rate of 110 words per minute for a period of five minutes.
3. Transcription of both of the above.
4. Spelling, punctuation, neatness of writing in transcription, proper arrangement into paragraphs, and general business-like appearance to be taken into account in judging of the candidate's performance.

Typewriting.—

Candidates will be expected to copy passages of varying difficulty, technical commercial, legal, tabular statements, etc., and to transcribe from badly written and confused manuscript. Candidates must possess knowledge in connection with typewriter copying, and the mechanical construction of the typewriter where that bears upon possible accidents and requirements of daily occurrence in an office. Candidates will be expected to shew a knowledge of duplicating processes. Special attention should be paid to accuracy, correct spelling, syllabication and punctuation, and general intelligence. The papers given will cover the ordinary range of subjects that fall within the province of the typist and correspondence clerk. Candidates will be allowed to use any make of machine they choose. Those in a position to bring their own machines are recommended to do so.

17. *Commercial—Education Pamphlets.*—A very valuable series of lectures are published by the Commercial Education Department of the London Chamber of Commerce. These deal with important questions ef interest or of direct moment to higher commercial education. In one instance the publication has been finely illustrated. (See No. 11).

The

The following list will give the scope of the papers:—

No.	Paper	Net Price s.	d.
No. 1.	"Insurance and the Machinery of Lloyds." By Col. H. M. Hozier, C.B. (Secretary of Lloyds)—Two lectures	0	6
2.	"Bills of Exchange and their Functions." By Herbert Tritton, Esq. (Barclay & Co., Ltd., and Ex-President of the London Chamber of Commerce)	0	3
3.	"The Stock Exchange and its Machinery." By Charles Duguid, Esq. (Fellow of the Institute of Journalists, Financial Editor of the *Morning Post*, and author of the "Story of the Stock Exchange," "How to read the Money Article," etc.—Two lectures	0	6
4.	"The Telegraphic Lines of the Empire." By Sir Edward A. Sassoon, Bart., M.P.	0	3
5.	"Book-keeping in its relation to Commerce." By James Martin, Esq. (Secretary and Fellow of the Society of Accountants and Auditors)	0	3
6.	"Education Preparatory to Commercial Pursuits." By George N. Hooper, Esq. (Member of the Council of the London Chamber of Commerce and Deputy-Chairman of its Commercial Education Committee)	0	3
7.	"Foreign Exchanges." By C. Rozenraad, Esq. (President of the Federation of the Foreign Chambers of Commerce in the United Kingdom, Fellow of the Institute of Bankers and of the Royal Statistical Society)—Two lectures	0	6
8.	"The City Guilds and their relation to Commerce and Education." By Charles Welch, Esq., F.S.A. (Librarian to the Corporation of the City of London)	0	3
9.	"The Chambers of Commerce and their Functions, including Commercial Education." By Sir Albert K. Rollit, LL.D., D.C.L., M.P. (Ex-President of the London Chamber of Commerce, and Chairman of its Commercial Education Committee)	0	3
10.	"Marine Insurance: Its Principles and Practical Working." By Douglas Owen, Esq. (of the Inner Temple, Barrister-at-Law, Secretary of the Alliance Marine and General Assurance Company, Ltd.; joint author of "Digest of the Law of Marine Insurance," &c.)	0	6
11.	"Producer-Gas, and its application to Industry." By H. A. Humphrey, Esq., F.C.G.I., A.M.I.C.E., M.I.Mech.E., M.I.E.E. (Consulting Engineer)	0	6
12.	"The Customs System of the United Kingdom and its connection with British Commerce." By J. A. Kempe, Esq., C.B. (Deputy Chairman of the Board of Customs)	0	3
13.	"The Development of the Motor Traffic and its connection with Commerce." By the Hon. C. S. Rolls., M.A. (Member of the Automobile Club)	0	6
14.	"The Development of Western Canada." By W. L. Griffith, Esq. (Secretary to the Office of the High Commissioner for Canada)	0	3

18. *Concluding Remarks.*—It will be seen that the scheme of commercial education of the United Kingdom has been greatly improved and promoted, but in every grade it does not reach the specialism of the best Continental systems. The influence of the London Chamber of Commerce has been followed by an immense advance, however, and it is forcing schools to pay marked attention to the requirements of those who need preparation to pass courses that reflect the opinion of commercial men as to what is needed as an equipment for commercial life.

CHAPTER LII.

Commercial Education in Belgium.

[J. W. TURNER.]

Introduction.—Elementary commercial instruction is given in the upper primary schools of Belgium to pupils, boys and girls, from the age of 12 to 15, and, as in other countries, is a preparation for early entrance into business. The most striking feature in the programme of the commercial sections of this class of schools is the number of languages taken, no less than three, beside the mother tongue, being taught.

The following is the time-table of one of the upper Primary schools of Belgium with a commercial section:—

Subjects.	Number of Hours per week.			
	Boys.		Girls.	
	First Special Year.	Second Special Year.	First Special Year.	Second Special Year.
A.—General Course.				
1. Religion	2	2	2	2
2. Mother Tongue	4	4	4	4
3. Second Language	4	4	4	4
4. Third Language	4	4	3	3
5. Geography	1	1	1	1
6. History	2	2	2	2
7. Arithmetic and Algebra	4	3	....	....
8. Chemistry	....	1	....	....
9. Music	1	....	1 h. during	recreation.
10. Gymnastics	2	2	1½	1½
11. Arithmetic	....	....	3	2
12. Domestic Economy	....	....	1	2
13. Needlework	....	....	1	1
	24	23	22½	22½
B.—Special Course.				
1. Commercial Arithmetic (two hours during first half-year of Second Special Year). 2. Elementary Commercial Law (two hours during the second half-year of Second Special Year).	....	2	....	2
3. Accounts and Book-keeping	5	4	5	4
4. Economic Geography	....	1	....	1
5. Fourth Language	2	2	2	2
	31	32	29½	31½

Secondary Commercial Schools.—Admission from the elementary school to the athénée, or Belgian secondary school, does not take place before the age of 11. For the first two or three years of a course of seven years the instruction in the athénée is general; and then, about the age of 14, a division of studies into two sections, one of which is commercial, is made. The commercial section has two divisions, viz., a lower side, which prepares boys to become ordinary clerks or business men, and an upper side, which enables students to proceed to the Institutes of Commerce. The majority of boys in the commercial sections of the athénées go at once to office; those who intend to take a prominent part in the business world, and who have the means for further training, are enrolled in the Institutes of Commerce, of which those of Antwerp, Brussels, Louvain, La Louvière, Liège, and Gand are of very high rank. Boys pass from the athénée on the termination of their seven years' course, about the age of 17 or 18, to the Institute of Commerce. Early admission to the higher commercial schools is deprecated by some of the Professors, who hold the opinion that the boys would be better prepared to receive the lectures of the Institutes if they remained longer at the secondary school.

The following is the syllabus of the different classes in the purely commercial section of the athénée:—

5th Class.—Agents and institutions relating to home commerce. Invoices, accounts of purchase and sale, way-bills, commercial correspondence.

4th Class.—Revision of preceding; principal obligations of a merchant under the code, bills of exchange, bills to order, book-keeping in single entry, incidental books, general principles of book-keeping in double entry, practical exercises.

3rd Class.—Revision; agents and institutions concerning specially foreign commerce, subdivision of general accounts; special accounts—consigners, merchants, bankers, and partners; commercial law, in relation to deposits and companies; accounts, current and at interest; annuitants' accounts, commercial correspondence, practical exercises.

2nd Class.—*Résumé* of principles of accounting, exchange and its combinations, arbitration and bank orders, currency (gold and silver), arithmetic exercises applied to these different operations; commercial law, contracts, sales, and purchases; history of the industry and commerce of Belgium to the close of the 15th century; industrial and commercial geography of Belgium, study of the nine provinces (nature of the soil, principal natural and industrial productions, commerce, modes of communication, remarkable localities).

1st Class.—Revision; Government stock, shares and obligations, repayment of loans, exchange operations, annuities, life and property insurance, savings bank and old-age pensions, practical exercises, speculative commerce, civil law, commercial code and special enactments, political economy; history of Belgian trade and industry from 1500 to the present time; sketch of the development of the principal branches of industry since Belgian independence, Belgian commercial and industrial geography, commerce, import, export, and carrying trade.

Time-table of commercial section in the athénée. The 7th class is the lowest, and the 1st class the highest.

Subjects.	Classes.						
	7	6	5	4	3	2	1
Religion	2	2	2	2	2	2	2
French	7	8	7	7	5	5	6
Flemish	7	6	3	3	3	3	3
German	......	2	4	3	3	3	2
English	......	......	......	2	3	3	2
History	2	2	2	2	2	2	2
Geography	1	1	1	1	1	1	1
Mathematics	3	3	4	4	3	3	3
Natural Science (not including practical work in 1st and 2nd classes)	......	......	2	2	3	4	4
Commercial Science	......	......	1	2	3	4	4
Drawing	2	2	2	2	2 hours (optional).		
Music	Taken during recreation.						
Total hours per week	24	26	28	30	28	30	29

Commercial Instruction of a secondary character is also given in schools known as commercial and industrial schools. The Professional School for Girls in Antwerp has an attendance of 300. Pupils are not admitted under 12 years of age, and must have reached the primary school standard. The school has a general preparatory course, which lasts two years. This general course is followed by special courses of three years, of which one is for commercial subjects.

The higher commercial education of Belgium is supplied by the Commercial High School of Antwerp. The course extends over three years. The sole object of the school, in the first and second year of the course, is the teaching of the commercial sciences, theoretically and practically. The third year affords students a special preparation for consular service. A distinctive feature of the teaching is the commercial bureau, by means of which the students are trained in a practical manner in the affairs of business and banking. The students are first practised in their lecture room in all the forms of mercantile procedure, each commercial document being thoroughly explained. Then the regular business of a business house is undertaken by fictitious operations, each student in turn filling all the different positions, keeping the books and carrying on the correspondence, first in his own language, and later on in the different foreign languages. The building is a splendid structure, and its commercial museum, which contains four galleries full of commercial products, is among the finest on the continent.

CHAPTER LIII.

CHAPTER LIII.

The Higher Institute of Commerce, Antwerp.

[G. H. KNIBBS.]

1. *Introductory Observations.*—As will be disclosed by a study of the curriculum given hereinafter, the Higher Institute of Commerce, Antwerp affords a commercial education of a very high character. It is one of the more notable Commercial High Schools of Europe. It was established by the Royal decree of 29th October, 1852, at which time there were two-year courses only, but on the 12th January, 1897, a third year course was added, having as its special object consular instruction. There is also a preparatory course, the subjects of which form the basis of the Entrance-examination, and are also identical with those taught in the professional sections of the Athénées, Colleges, and Gymnasia. The following account—a translation of an official document obtained by the Commissioners during their visit to Antwerp—will give a fair indication of the breadth of ideal and of the extent of the aims of the Belgian people in regard to commercial education.

Though expressed in a somewhat condensed form, the following indication of the courses gives not only their details but also a general idea of the organisation of the Institute.

The Commissioners, on the occasion of their visit, were impressed with the excellence of the school and of its equipment. The elaborate collections of this and other European schools are of great value to those who wish to learn something of the world's commercial products, and their origin and appearance.

2. *Importance of Detailed Programmes.*—A mere time-table, or programme, gives no adequate conception of a course. Since commercial education with us is in its infancy, it is very desirable that a proper understanding of it should be given. For this reason the Commissioner here writing has undertaken the translation of a number of programmes with the object of rendering it possible to obtain a clear idea of the whole development of the commercial courses, and to reveal their thoroughness.

In commercial life it is important to remember that we are in competition not only with all nations, but also with individuals who will take the trouble to learn our language, and that our commercial position will depend upon our being the peers of commercial men in other countries, and further, that the rapid development of foreign commerce is totally altering the general aspect of the problem of holding our own in this branch of human activity.

The recent history of German commercial successes, of American reaction thereto, and the strenuousness of recent endeavours in America to educationally reinforce her commercial power, shew clearly enough that our duty to the rising generation of this territory demands that we should make provision for commercial instruction comparable in breadth and thoroughness with the provisions made in Europe.

The crude opinions of these who have not systematically studied the subject, cannot be admitted as a sufficient guide. The distinguished success of European commercial schools, the incisive criticism of their own methods, the keenness of European competition, the wealth of their educational commercial experience, the fact also that the mother-country has been forced to follow their example in commercial education, all point to the fact that we shall do well, in formulating our ideas of commercial education, to first study thoroughly the highly developed methods of Europe.

Every item in their programmes represents a long course of criticism and of comparison with the work done in other countries, and it is impossible to visit the European commercial schools without recognising the fact that they are in the first rank of commercial training.

3. *The Higher Institute of Commerce, Antwerp.*—The following is a complete account of the organisation and curriculum of the Higher Institute of Commerce of Antwerp, translated from the original documents. It aims at disclosing the scheme by which commercial men are trained in one of the most important cities of Belgium.

The entire course of theoretical and practical instruction of the Higher Institute of Commerce for ordinary students lasts two years. By decree of the 12th January, 1897, however, a third year of studies has been added for those who desire to take it, the special object of this additional year being devoted to consular education. It is not intended for all students of the Institute.

4. *Inscription and Registration of Students.*—Students may enter for courses in individual subjects at their pleasure, or for the courses prescribed for a complete commercial course.

The entry of the name as a student of the Institute on its roll takes place annually, the *fee* being 25 francs (£1). Where students enter for at least five courses the fee is 5 francs (4s.) per course. When registered on the roll a student takes either a "general registration" for all the courses constituting one year of study, or a "special registration" for certain prescribed courses. The registration fees for the whole year are payable in advance.

General Registration.[1]—Registration for the whole of the courses of the first year may be taken only by students who have obtained the right by examination, the subjects of which are indicated below. The passing of the examination gives the title "1st year student."

The cost of general registration in all the first-year courses, is 200 francs (£8).

General

[1] The registration of the student's name as a regular student.

General registration in all the courses of the second or third year, may be taken only by students who have obtained the right through passing an examination bearing on the subjects taught during the first and second year of studies and indicated in the programme. The passing gives the title "2nd year student," or "3rd year student."

The cost of general registration in all the courses of the second or third year, is 250 francs (£10.)

Each registration may be renewed every two years; half-fees only being charged in such a case.

Special Registration.—Special registration for one or more courses is taken by those who do not desire to pass examinations, at the rate of 30 francs per course, and of 15 francs for each renewal (24s. and 12s.)

For special registration in the *Commercial Bureau*, a fee of 100 francs (£4), per year, is charged. This registration is granted only to pupils who have previously registered for at least four courses of the first or second year. Special registrations may be made at *all periods of the year*; but no reduction in terms is made when the courses have begun.

No preliminary qualification is required for special registrations, excepting for the Commercial Bureau, where admission is subject to an examination passed before the "*Chef de Bureau*," on the elements of book-keeping, French, the rudiments of German and English, and commercial calculations.

Pupils inscribed for special courses only cannot obtain the diploma of the Institution on leaving it.

5. *Examinations.*—The *Examination* of pupils for the first year (Entrance-examination) is held annually in the first week in October before a committee appointed by the Minister of Industry and Labour, and presided over by the Director. There is no examination at Easter. The subjects of this examination are the subjects also of instruction of the professional sections of the Athénées, Colleges, and Gymnasia, and of the Preparatory Course of the Institution itself. They are:—

(1) A composition in French, and a translation from French into English and German. (2) Physical Geography. (3) The rudiments of Universal History, the periods chosen for examination being annually fixed in January, by the Director. (4) Arithmetic, with its application to Commerce and the elements of Book-keeping. (5) The elements of Algebra and Geometry (according to Legendre, four first books). (6) Elementary Conceptions concerning Physics and Chemistry. (7) Commercial law. (8) Political Economy.

Pupils who have previously studied in an Athenæum or other national institution of equal legal standing, or who prove by certified documents that they are capable of receiving the instruction given in the Institution, are exempted by the Board of Examiners from the Entrance-examination, provided that they have also reached the necessary standard in the French, English, and German languages. Students coming from the *Latin Rhetoric* division[1] of the Athénées should pass an examination in book-keeping, political economy, commercial law, arithmetic and chemistry; those who can prove by a certificate that they have attended this last course, need not undergo an examination therein. Diplomas and certificates should be remitted to the Director before the 30th September.

The programme is modified for foreigners, especially in regard to languages.

The Examination of pupils for the second year or transition period is conducted by a Board of Examiners composed of Professors of the Institution, presided over by the Director, at the end of every school-year, the subjects of which are indicated in the programme.

At the end of the second year, a Board of Examiners appointed by the Government, present to the pupils possessing the requisite knowledge, diplomas (*diplôme de capacité*) conferring the title of "*licencié en sciences commerciales.*" The Belgian student to whom this diploma is awarded may obtain a several years' scholarship to enable him to travel abroad at the expense of the Government. A sum of 60,000 francs (£2,400), is entered for this purpose in the annual budget of the Minister for Foreign Affairs. The subjects of examination for the obtainment of the "*diplôme de capacité,*" are indicated in the programme. At the termination of the third year, students become eligible for the diploma of "*licencié du degré supérieur en sciences commerciales et consulaires.*"

6. *Preparatory Course.*—A preparatory course including the subjects of the Entrance-examination is instituted. This course begins at Easter and terminates on the 1st of August. The cost of registration is 100 francs (£4).

7. *Miscellaneous and Minor Regulations.*—All the courses of the Institution begin from the 10th to 15th October, and are given in the French language. Foreign students should specially endeavour to gain a thorough familiarity with this language, without the knowledge of which progress is impossible. The business *of the Commercial Bureau* is treated *in the principal modern languages.*

Each professor maintains the discipline of his course; he warns and advises students and may expel those who are unruly.

The students may render themselves liable to the following punishments:—Reprimand, suspension of the right of attendance at one or more courses, caution, and expulsion from the Institution.

Students must regularly attend the courses for which they have registered, and in the event of being prevented must send word to the Director, beforehand when possible, of the reason of their absence. Absences are noted, and notices sent to the parents or guardians of a pupil.

Examinations for all the courses are written and oral and are held throughout the year; marks are given for each subject as at the final examinations of the year. The average of the marks obtained during the year is taken, and the average between the result obtained and the marks of the final examination of the year determines the admission of the student and the grade of the diploma. The registration-fee is 25 francs (£1) for the entrance-examination; 50 francs (£2) for that of transition examination; 75 francs (£3) for the examination of the second year; and 100 francs (£4) for that of the third year.

Students procure at their own cost books, exercises, blotters, and the necessary writing paper, etc. at the Bureau.

A Museum of specimens, of natural and manufactured products, of native and foreign origin, a *Library* and a *Laboratory*, are connected with the Institution. The course in practical Chemistry is a separate charge.

8

[1] See Report on Secondary Education, chap. XI, pp. 128–129.

8. *Special Lectures.*—Lectures on the principal articles of Commerce, merchandise, exchange operations, may be given to second or third year students either by brokers, merchants, or persons of sufficiently general experience. In company with the Director and one or several professors the students visit the principal mercantile and industrial establishments of the city and neighbourhood.

9. *General.*—The Institution has two annual vacations—one is from the 15th August to the second Tuesday of October, and the other a week at Easter.

The Institution is appointed after the manner of a University. As a consequence the pupils do not lodge therein, but reside in the city, either at the homes of the professors or in private houses, according to the wishes of their parents.

Administration.—The Institute is administered by a Higher Committee composed of seven members, of which the *Burgomaster of Antwerp* is the President *ex officio*. The other members are appointed as follows, viz., three by the Government, and three by the Communal Council of Antwerp.

The Governor of the province of Antwerp presides at the administrative committee whenever he attends the meetings.

The functions of the Director are:—(1) The direction of studies and the internal administration of the Institution; (2) The maintenance of order and discipline; (3) The maintenance of relations between the Institution and the authorities and the parents of the pupils; (4) The accountancy and receipts, etc.; (5) The registration in the various courses, and the delivery of cards of admission to each of these; (6) The preservation of the various collections, the furniture, and buildings.

10. *Programme of the Courses in the Institute.*—The details of the curriculum of the Institute disclose the scheme of instruction better than anything else. A bald statement of the subjects taught is not sufficient, because unless our own educational system and machinery are equal, the mental picture raised by a mere statement that this or that subject is taught is quite inadequate.

The general programme, however, compiled from the detailed statement will give an aperçu of the whole course. It is as follows:—

Programme of the Institut Supérieur de Commerce d'Anvers.

Subjects.	Years and Hours per Week.		
	I.	II.	III.
Commercial Bureau with Commercial Arithmetic, etc.	15	15	...
History of Commercial Products	2	2	...
History of Commerce and Industry...	...	2	...
Political Economy and Statistics	2	?	?
Commercial and Industrial Geography	3	?	...
General Principles of Law ...	2	..	...
Commercial and Maritime Law	...	2	...
German Language (technical)	3	3	...
English " "	3	3	...
Dutch, Flemish (obligatory for Belgians)	3	2	...
Spanish...	3	3	...
Italian ...	3	3	...
Customs Legislation ...	...	1	...
Shipping, the Mercantile Navy	...	1	...
Accountancy and Banking	...	...	?
Constitutional Law	...	...	?
Administrative Law	...	...	?
Comparative Commercial and Maritime Legislation	...	...	?
Law of Nations	...	...	?
Industrial Technology	...	...	?
Transport	...	...	?

11. *Commercial Bureau* (*Lower Section*) 15 *hours per week.*—The details of the work are as follow:—

Fictitious operations of a mercantile establishment dealing with all manner of business: the bank, merchandise, stock-in-trade, on own account, for sale or return, on joint account, etc.

Application of commercial calculations and accountancy, invoices, account-sales and purchases, accounts of expenses, accounts-current, net profits on merchandise, etc. Exchange operations, arbitration, public funds. Entry of each transaction in books regularly and practically kept by double entry. Bills of Exchange, bills to be settled, to be indorsed, invoices, bills of lading, charter parties, contracts of bottomry, warrants, insurance contracts, outstanding-accounts and particular averages. Statements of "*avaries grosses*" ("loss by tempest, shipwreck, capture, or ransom,") etc. Usages of Antwerp and the principal foreign places, comparison of weights, measures, etc.

Correspondence in French, Dutch, English, and German, for the purpose of giving or receiving orders, the buying and sale of merchandise, the consignment of ships and cargo.

Balance-sheet and liquidation of the establishment at the end of the year.

Commercial Arithmetic.—Repetition of the fundamental operations, vulgar and decimal fractions, aliquot parts, proportions, explanation of the rules of interest, discount, partnerships, mixture, alligation, division, etc. Average maturity. Accounts-current and interest (direct, indirect, and Hamburg methods). Net profits. Exchanges. Public funds. Bullion. Negotiations. "*Arbitrages*" as to these various values.

12.

12. *History of negotiable products* (2 hours per week).—This course is given with the aid of the specimens of the Museum attached to the Institution.

Products of the Mineral Kingdom—

(A) *Non-metallic substances*: Sulphur—Arsenical products. Phosphorus. Carbon and its compounds. Graphite, coal, coke, turf, anthracite, ground charcoal, charcoal employed as a colour, animal charcoal, petroleum and its derivatives. Carbon disulphide. Chlorine and alkaline chlorides (hypochlorites). Iodine. Bromide. Mineral acids (sulphuric, nitric, hydrochloric, boric, and hydrofluoric).

(B) *Metallic substances*: Potassium, potash and salts of potassium. Sodium, soda and sodium salts. *Alkalimetry*. Ammonia, Lime, Barium, Magnesium, Aluminium, and their compounds. Various kinds of earth (kaolin, clays, ochres). Various kinds of stones (pumice-stone, trass, tripoli, emery, etc. Building stones, slates, marbles, gem stones diamonds). Manganese and its compounds. Iron. Chromium, cobalt, zinc. Tin, lead, antimony. Bismuth, copper. Mercury. Silver and its compounds. Gold. Platinum.

(C) *Products of the Vegetable Kingdom*—

Roots.—Edible, aromatic, tinctorial, spices, medicinal, industrial.

Barks.—Aromatic barks, spices, medicinal, tinctorial, tanning, and other barks for special purposes.

Wood.—For building and carpentry; cabinet-work; dyeing; medicinal; firewood.

Bulbs.—Alimentary, flower bulbs.

Leaves.—Laurel, senna, sumac, tea, maté, tobacco.

Flowers.—Medicinal, aromatics, industrial spices.

Fruits and Seeds.—Table fruits. Coffee. Cocoa. Cereals or grains. Rice. Farinas. Dried vegetables. Aromatic spices. Oleaginous fruits and seeds, fodder seeds. Fruits and seeds which are employed in industry. Medicinal fruits and seeds.

Textile fibres of vegetable origin.—Cotton, European hemp. Manilla hemp. Pitte hemp. Hemp and jute. Flax. Coco-nut fibre.

13. *Political Economy and Statistics.* (2 hours per week).—The details are as hereunder:—

(i) *Object of political economy*, its utility and nature. Causes which have retarded its progress.

(ii) *Production.*—Analysis of the elements of production. Labour. Natural agents. Capital: its elements and the rôle it plays in production. Classification of capital. How capital is formed and grows. Importance of its growth.

(iii) *Examination* of the causes of the more or less great productivity of the productive agents in the various countries. Property. Division of labour. Ideas of Adam Smith in reference thereto.

(iv) *Value.*—Economic signification of the word. Laws regulating the value. Supply and demand; costs of production. Price.

(v) Money. Value of money. Fluctuation in value of precious metals and their economic and social consequences.

(vi) *Credit.*—General idea of credit. Its importance in production. Credit or banking establishments. Various kinds of banks: deposit, commercial, and currency banks. Circulation of non-reimbursable paper or paper-money. Credit as a means of economising the employment of money. Influence of credit on prices. Commercial crises. Landed, personal, agricultural credit, etc.

(vii) *Balance between production and consumption.*—The question whether there can be an excess of production.

(viii) *International trade.*—Necessity and advantages of this trade. Free-trade between the various nations and the protective system. Intervention of money in the international exchanges. The Exchange.

(ix) *Forms of production.*—Principle of Partnership. Trading Companies. Large and small production.

(x) *Distribution of wealth.*—Wages. How they are regulated. Population. Inquiry into the ideas of Malthus with respect thereto. How the condition of wages may be ameliorated. Profits. Analysis of the elements of which they are composed. How they are regulated. Rates of interest. Examination of the laws which limit this rate. Landed annuity. Ricardo's theory.

(xi) *Resources of Governments* for the satisfactory administration of the public service. Tax. Its influence on the development of wealth. Necessity of taxation. Progressive and proportional tax. Income tax. Incidence of taxes, or the persons who pay them. Public credit. State loans. Annuity issues. Amortization and great exceptional requirements.

(xii) Statistics, their aim, utility, characters, divisions, etc., etc.

14. *Commercial and Industrial Geography* (3 hours per week).—These subjects are developed as hereunder. The topographical and statistical information concerning the various countries of Europe, Asia, Africa, America, Australia, and Polynesia, is obtained from the latest consular reports, and most recent communications. This information relates to the following points, viz.:—

(i) *Topographical situation.*—Constitution of the soil, mineral, vegetable, and animal kingdoms.

(ii) *Political and social state.*—Institutions, their influence on the prosperity of the country. State of the public finances, national wealth, prosperity or decay, their causes.

(iii) *The principal productions* of each country; commodities that may be derived from them with advantages. *Tables of exportations.*

(iv) *Imports.*—The principal products required to be imported by each country. Those contributed in particular by Belgium. Those that she could further contribute. Tables of *importations.*

(v) *Customs.*—Aperçu of the character of the economic and customs legislation of each country. Their obstacles and facilities for commerce. Tastes and habits of the peoples as far as their relations with commerce are concerned.

(vi) *General.*—Detailed notice concerning the principal trading towns, their importance, their business methods, etc. Sources and causes determining the commercial relations between the various countries.

15.

15. *Law: outline of its general principles* (2 hours per week).—The course is treated as indicated hereunder:—

The study of the elements of commercial law. General ideas concerning ethics and natural law. résumé of the subjects contained in the first two books of the Civil Code: laws in general, minority, tutelage, and emancipation; property; distinction between personal and real estate. Study of the general scheme of obligations; the formation of contracts, their essential conditions, their effects between the parties concerned and in respect to third persons. Various kinds of obligations, conditional, conjoint liability, with penal clauses. Modes of extinction of obligations. The proof of obligation; authentic and private deeds, evidence of witnesses; theory of the oath. Examination of deeds of sale, hiring, partnership, loan, deposit, mandat, security, etc. Ideas concerning licenses, mortgages, and limitations.

16. *German, Lower Section* (3 hours per week.)—The instruction in the languages is technically orientated. German is treated as follows:—

Terminology for letters and the principal articles of commerce. Commercial correspondence. Instruction with respect to German commerce: Custom duties, dues, exchanges, markets, shares, bonded warehouses, ports, banks, brokers, chambers and tribunals of commerce, conversation.

17. *English, Lower Section* (3 hours per week).—English is developed as hereunder:—

Commercial terminology. Commission business. Buying, selling. Despatch of merchandise. Insurance. Lloyds. Commercial bills. Banks. Companies. Public funds. Monetary circulation. Contracts. Custom duties. Formulæ. Correspondence. Conversation.

18. *Other languages.*—The other languages are taken as hereunder:—

Dutch, Lower Section, obligatory for Belgian pupils (3 hours per week).—Commercial terminology and correspondence. Conversation.

Spanish, Lower Section (3 hours per week.)—Pronunciation, reading, grammar, dictation, exercises and translations, memory exercises, commercial correspondence. Slava's Dictionary, Soto's Ochando.

Italian (3 hours per week.)—Pronunciation, reading, grammar, dictation, exercises and translations, commercial epistolary style, exercise and commercial letters from dictation. Moretti's Grammar, Barberi's Dictionary.

The student need follow only one of the two last courses.

19. *Second Year Courses, Commercial Bureau.*—The work of the second year closes the ordinary course, and on satisfactorily passing it the student receives the diploma "*Licencié en sciences commerciales.*" As seen from the Programme, most of the work is essentially a continuation of the first year's work. The work of the Commercial Bureau occupies 15 hours per week.

(i) *General.*—Complimentary study of the conditions of buying and selling, and general customs of the trading ports of various parts of the world. Importation, exportation, transit, commission, insurance, banking. etc. Application of calculations to "arbitrages." Accounts to be kept, to be made, exchange operations, intelligence to be received or given. Application to practical questions of the theoretical ideas acquired in all the other courses. Disputed claims, practical transactions and accountancy. Commercial, financial, and industrial relations to be established with the various countries. Correspondence in French, Dutch, English, German, Spanish, and Italian.

(ii) *Commercial Intelligence.*—In addition to the indications of the Antwerp Exchange, the Commercial Bureau of the Institution receives regular commercial intelligence from London, Liverpool, New York, Havanna, Rio Janeiro, Buenos Ayres, Valparaiso, Sydney, India and China, Odessa, Hamburg, Amsterdam, Havre, etc.

This information is communicated to the pupils in the original languages.

(iii) *Commercial Arithmetic.*—Questions of compound interest, of annual investments and annuities; numerous applications to the questions concerning loan, amortizations, life-annuities, etc. Crédits fonciers, obligations, premium-loans, insurances; principles for the calculations of premiums; marine fire and life insurances, tables of mortality, "*dotale*" insurances, tontines, railways, tariffs, etc.

20. *History of Negotiable Products* (2 hours per week).—The specimens of the Museum, attached to the Institution, are requisitioned for this course, as for the first year. The course consists of the examination and study in continuation of the *Products derived from the vegetable kingdom* of the following, viz:—

Cellular Plants—Agaric, edible mushrooms. Medicinal and theoretical lichens.

Excrescences or Galls.

Vegetable Products—

(a) *Tinctorial Pastes:* Indigo, woad, archil, annotto, madder, prepared dyer's woad, etc.
(b) *Inspissated Saps, etc.:* Cachou, gum kino, aloes, opium, essence of liquorice.
(c) *Feculæ:* Amidon, fecula, arrowroot, tapioca, sago, macaroni, vermicelli, etc.
(d) *Sugar Products:* Raw and refined sugar, loaf sugar, sugar crystals, molasses, honey, manna.
(e) *Gums:* Arabic, Senegal, tragacanth.
(f) *Resinous Gums:* Ammoniacum, bdellium, euphorbium, galbanum, myrrh, etc.
(g) *Elastic Gums:* Caoutchouc, gutta-percha.
(h) *Resins:* Copal, dammar, elemi, shellac, etc., etc.
(i) *Oleo-resins.*
(j) Turpentine.
(k) Tar: Pitch, "oil" of tar.
(l) Bitumens.
(m) Balsams.
(n) Fixed oils.
(o) Essential or volatile oils; artificial essential oils.
(p) Fermented products.
(q) Vegetable acids and salts.

Products

Products derived from the Animal Kingdom—

Cantharides, cochineals, "kermes-animal." Animal perfumes. Horns, bones, glues. Skins (hides), furs, hairs, horse-hair, feathers, wools, animal fats, animal alimentary matters, animal manures.

Manufactured Products—

(A) Metallurgic industry. (B) Ceramic industry. (C) Industrial Chemistry. (D) Linen trade. (E) Woollen industry. (F) Cotton industry. (G) "Industrie sétifère." (H) Various industries.

The pupils are initiated into the operations of commercial chemistry, and there is a specially equipped laboratory for this purpose.

21. *General History of Industry and Commerce* (2 hours per week).—This subject is treated as shewn hereunder:—

(I) *Antiquity*.—History of Commerce and Industry from the earliest historical times to the fall of the Roman Empire. Rise of industry and commerce. The leading arts and their inventors. Industry and commerce in Phœnicia, Egypt, Palestine, and India. Commerce of Carthage. Industry and commerce of Greece and Rome. Slavery in antiquity. Its organisation and influence on the development of industry and commerce. Ways of communication in antiquity. State of industry and commerce and social conditions of the nations at the time of the fall of the Roman Empire.

(II) *Middle Ages*.—From the fall of the Roman Empire to the discovery of America (1492). Reorganisation of industry after the invasions of the Barbarians. Régime of the corporations or guilds. How and under what necessities it was established. Description of this régime. Obstacles opposed by the feudal régime to the development of industry and commerce. Causes of the commercial prosperity of the Italian Republics and cities of the Hanseatic League. Aperçu of the commerce and industry of Flanders. Special reasons for the prosperity of Antwerp from the beginning of the Middle Ages. State of the world's industry and commerce at the period of the discovery of America.

(III) *The Renaissance*.—From the discovery of America to the invention of the steam-engine. Influence of the discovery of the New World on industry and commerce. New colonies and the colonial régime. Injurious effects of this régime. The commercial prosperity of Holland and its causes. Decadence of the industry and commerce of Belgium after the treaty of Munster. Manufacturing system of Colbert and its influence on the development of French industry. The Edict of Nantes and fatal effects of the religious persecutions on industry and commerce. The Navigation Act of Cromwell. The Creation of the Bank of England and the Banks of Scotland. Laws' system and the evils arising therefrom. Rise of economic science. History of the first steps of political economy and of the economic writers. Aperçu of the state of industry and commerce at the time of the invention of the steam-engine.

(IV) *Modern Period*.—From the invention of the steam-engine to the present time. Inventions of Watt, Arkwright, Hargreaves, Crompton, etc., and their influence on production. Character of the great industry to which these inventions have given birth. Impulse given by them to the industry and commerce of England. French Revolution and its reaction on universal industry and commerce. The extent to which it has accelerated and retarded productive development. The Continental Blockade and its effects. Industrial and commercial progress realised by the principal nations of the world from the peace of 1815 to the present time. Development of ways of communication, principally railways, steamboats, and electric telegraphs. Economic reforms of England and their influence. Critical appreciation of socialism. The position of the working-classes and the practical improvements possible therein. Improvements effected by the progress of industry and commerce. Progress to be realised. Under what conditions. General state of industry and commerce at the present period. Monetary questions. Emigration, its causes, its influence. Recapitulation: progress realised by Society. The reason of the universal extension of civilisation.

22. *Commercial and Marine Law: Principles of the Law of Nations* (2 hours per week).—These subjects are developed as hereunder:—

Study of the Commercial Code and modifications produced therein to the present day. Merchants, books of commerce. Various kinds of companies: in collective name, in limited joint-stock company, joint-stock company, co-operative, in participation. Jurisdiction by arbitration. Brokers and stock-brokers. Commission contract. Bills of exchange and other commercial bills.

Marine law.—Vessels and the obligations which rest upon them. Responsibility of ship-holders. Laws and obligations of captains and crews. Charter-parties, bills of lading. Freight. Bottomry. Theories of insurances; explanations of the marine insurance policy of Antwerp. Averages. Failures and bankruptcies. Principal commercial laws. Laws concerning the consulate. Law concerning warrants. Disciplinary and penal Code for the Mercantile Navy and marine fishery. General ideas concerning commercial and marine legislation of the principal countries.

Principles of the law of nations in their relation to commerce. Relations between States. Divisions and purpose of this law. Public treaties. Diplomatic and consular relations. Form, division of public treaties. Laws pertaining to neutrals in times of war. Consequences of truce.

23. *Customs Legislation* (1 hour per week).—The details of the course are the following, viz.:—

(I) Importance of this course. Relation between political economy and Customs legislation. Why modern nations attach so much importance to Custom and Tariff questions. The meaning of protection. Protection which favours the producer. Protection which ameliorates the conditions of labour by the improvement of transports, the creation of institutions of credit, technical education, etc. Means whereby the transition to free-trade can be effected in countries subject to the protective régime. The effect of decreasing tariffs. Statement and comparison of the systems of free-trade and protection.

(II)

(II) Different kinds of duties: duties pertaining to importation, excise, octroi, etc., duties pertaining to exportation, duties of transit, of navigation (tonnage and nationalisation); various characters of these duties. Different ways of applying and collecting the duties. Ad valorem duties, duties concerning weight. The pre-emption necessitated by the creation of duties on values. Criticism of these. Fraud. Necessary precautions for rendering it powerless. Frontier radius. Documents allowed in the Custom-house. Hindrances to commerce because of the necessary precautions to be taken for the prevention of fraud, and facilities accorded for the avoidance of it; transit, bonded warehouse, docks, free ports, etc. Restrictions of export duties. Premiums, drawbacks, release of excise duties. Duties on sugar. History in the principal countries. Duties on food-stuffs. Sliding scale. Duties on manufactured products, on mineral products, and preferential duties.

(III) Administration of the Customs, relation of the Customs with navigation; analysis of the customs-duty. Contraband.

(IV) Colonies, colonial system of Europe; economical and political effects of this system. Modern tendency to substitute freedom for restrictions. Double modification experienced in regard to the colonial system in England, 1883 and 1884. Colonial system of Holland.

(V) Commercial treaties. Declarations of reciprocity, their difference. Critical statement of the two systems. A general glance at the Belgian tariff; its changes since 1830. How the different commercial treaties have modified it. Study of the Customs reform in England commenced by Huskisson and completed to-day. History and constitution of the German Association, known under the name *Zollverein*. Result and extension of this Customs union. Customs-tariff of France, England, the United States of America, and other countries with which commercial relations are most frequent.

24. *Maritime Construction, etc.*—This course is both public and free. It occupies one hour weekly, and is developed on the following lines:—

(I) Nomenclature and description of the various parts of which the hull, the internal arrangements, the "*accastillage*" (the space occupied by the forecastle and quarter-deck), the rigging, the set of sails, and inventory of a merchant-ship, are composed. General ideas of displacement, etc.; of stability and metacentre. Influence of stowage on the stability of a merchant-ship. Tonnage calculation of a vessel according to the laws in force in the various countries. Influence exercised by the various modes of gauging on the forms of vessels of these countries. Relations existing between the principal dimensions of the various kinds of vessels.

(II) General ideas considered principally from the point of view of the shipowner, concerning construction, the maintenance and repairs of wood and iron vessels. Relative advantages and inconveniences presented by wood and iron for the construction of merchant ships. Knowledge of the distinctive characters of the different kinds of materials used for the construction of vessels. Performance of work, workmanship.

In order to make the study of this part of the course thorough, the pupils, accompanied by their professor, visit the dockyards and vessels in the port of Antwerp.

(III) General considerations concerning heat and its transmission through liquids. Combustion. Phænomena of ebullition and vaporisation. Steam, its principal properties: elastic force, expansion, condensation, etc. Description of the various parts of boilers, at low, mean, and high pressure, and their accessory organs. Relative advantages and inconveniences of boilers at low, mean and high pressure. General considerations concerning the management of fires, the service and maintenance of boilers and the means of preventing accidents. Tests to which boilers should be submitted before allowing them to be used. Description and functions of the organs of steam engines at low, mean or high pressure for wheel and screw vessels. Description and statement of the relative merit of the most usual systems of paddle or screw engines. General considerations concerning the management, the maintenance, and service of marine engines.

The pupils, accompanied by their professor, visit steam vessels at Antwerp, and the engines of those in course of construction are shewn them.

(IV) Explanation of the conditions required by English and French Lloyds (Veritas) for obtaining the classification of a wooden or iron vessel. Agreement to be entered into with the builders. Indication of the principal marine dockyards. Respective values of the vessels constructed there. Forms to be filled up for obtaining the naturalisation of a vessel constructed in a foreign country, and the passes of a national or naturalised vessel. Visits or surveys. Various modes of freighting and chartering. Heavy and cumbersome merchandise. Regulations in force in the various countries for the transport of emigrants. Accounts of armaments. Financial results to be obtained from a sailing or steam ship in relation to the capital engaged, either per voyage or by the year. General considerations from the point of view of the profits to be realised, on the various kinds of sailing vessels and steam-ships.

25. *Commercial and Industrial Geography* and *Political Economy and Statistics*.—Both these courses are a recapitulation and completion of the courses of the preceding year, and call for no special reference.

26. *Languages.*—The higher sections of the languages are taken as indicated hereunder:—

German (*Higher section*) 3 hours per week.—Commercial terminology. Commercial correspondence. The formulæ of commerce: invoices, account-purchases, account-sales, and net accounts, etc. Bills of exchange, receipts, Customs declarations, bills of lading, manifestos, charter parties, contract of partnership, of insurances, etc. Information concerning German trade, principally on the Customs and laws recently established.

English (*Higher section*) 3 hours per week.—English commercial law. Averages. Warrants. Patents. Joint stock companies and limited liability companies. Information concerning English and American trade. Formulæ and correspondence. English conversation.

Dutch

Dutch or Flemish (*Higher section.*)—2 hours per week. This is obligatory for Belgian students. Continuation of the preceding exercises. Style in general. Commercial letters. Forms and words principally employed. Translation of several classical authors. Conversation.

Italian (*Higher section.*)—3 hours per week. Continuation of the preceding exercises. Style in general. Commercial letters. Forms and words principally employed. Translation of the principal classical and contemporary authors: *Dante*, *Ariosto*, *Manzoni*, etc. Italian conversation.

Spanish (*Higher section.*)—3 hours per week. Continuation of the preceding exercises. Style in general. Commercial letters. Forms used. Translation of the principal classical and contemporary authors: *Gonzalvo* of *Cordova*, *Gil Blas*, *Antologia Espanola*, etc. Spanish conversation.

Students need take only one of these two last courses.

27. *Third Year Courses.*—The third year work ends, provided the final examination be satisfactorily passed, in the diplomas (*Licencié du degré supérieur en sciences commerciales et consulaires, ou en sciences commerciales et coloniales*). The accountancy and banking and law courses are developed as follows:—

Accountancy and Banking.—Banking companies, industries, banks, public funds. Study of the financial systems of the principal countries. Various systems of accountancy. Agricultural accountancy.

Constitutional Law.—History of the constitution of the principal States. Principles of the Belgium constitution; the liberties recognised by it. Ideas concerning the legislative, judiciary and executive powers. Exposition of the English, French, German, Congo constitutions, etc.

Administrative Law.—Organisation and competency of the administrative authorities. Functionaries administrating by way of execution. Powers intervening by way of deliberation. Administration of justice; armed force. The Congo administration. The public domain; land and seaways. Industry, mines, commerce, their regulation.

Comparative commercial and marine legislation.—Merchants and mercantile transactions as affected by the principal systems of legislation. Bills of exchange, commercial effects. Trading companies. Failure. Commercial tribunals. Marine law.

28. *The Law of Nations.*—*Principles.* History of States, of territory, of usage with respect to the sea, to rivers and to straits. Absolute and relative rights of States. Relations of the States during peace. Diplomatic agents, negotiations, treaties. History and examination of the principal treaties relative to intellectual rights (patents, manufacturer's marks, literary and artistic property, etc.), to material interests (money, fishing, commerce and industry); means of communication; railways, post-offices, telegraphs, telephones.

Consuls.—Aperçu of the legislations of the principal commercial countries. History, classification and hierarchy; nominations, incompatibilities; prerogatives of countries within and without Christendom; commercial and judiciary prerogatives; notarial functions of civil officers: various powers. Rights and prerogatives of consuls. Consular regulations.

Disputes between States.—Pacific and violent solutions: war; consequences of declaration of war in regard to belligerents and neutrals; commerce of neutrals during war. Acts, theatre and operations of war. Conventional relations of belligerents.

29. *Political Economy, industrial Geography, etc.*—The course in political economy is a recapitulation of the work of the first and second years, and a supplementary course in which economic and financial questions are more profoundly studied.

Industrial and Commercial Geography is supplementary in regard to the preceding courses. Detailed industrial geography of Belgium. Economic geography of various countries, of Congo, the Far East; colonies, protectorates and spheres of African influence. Special study of statistics of importation, exportation, transit, etc. Trade of the ports, bonded-warehouses, river fishing. Special statistics of Belgium and the principal countries.

30. *Industrial Technology.*—Study of the principal industries of Belgium; raw materials and their production; manufacture, qualities, classification, etc. Description of the processes of manufacture:—

(1) "Extractive" industries: Industries of mines, of quarries, manufacture of coke, of gas; manufacture of lime and cement.
(2) Metallurgical industries: Cast-iron, iron and steel industries.
(3) Ceramic industries: Bricks, tiles, drain-pipes, ceramic and cement bricks, porcelain, faïence, etc.
(4) Glass industries: Crystal and wine-glass manufactories, window-glass, plate-glass, etc.
(5) Chemical industries: Manufacture of sulphuric, hydrochloric, and nitric acids; soda, potash, chlorates, white lead, etc. The paper industry.
(6) Textile industries: Spinning of cotton, wool, flax, jute, etc. Manufacture of cotton, wool, flax, and similar goods, etc. Manufacture of cordage.
(7) Industries of construction: Foundry, coppersmith's trade, bridge-making and iron frame-works, construction of steam-engines and machine tools, locomotives and materials for railways and tramways.
(8) Alimentary industries: Milling, manufacture of sugar, beer, and alcohol.
(9) Miscellaneous industries: Tan-yard and curriery, leather dressing. The clothing industries: Hat-making, lingerie, shoemaking, confections, corsets, etc.

31. *Transport.*—This constitutes the second part of the course of maritime construction, etc. Railways, roads. The construction of stations. Rolling material: locomotives, tenders, passengers and merchandise carriages; carriage tariff of passengers and merchandise. Exploitation by the State and by companies. Suburban lines. Tramways. Internal navigation: Rivers, canals. Working material: Boats, towing boats, sailing-boats, lighters, etc. Tariff. Constructions: Materials, their uses, qualities, and defects. Bridges: Foundations, frames, roofings. Habitations: Stables, barns, mills, silos, pits, etc.

32. *Colonial Culture and Hygiene.—Culture:* Generalities concerning geology and meteorology from the point of view of the vegetable product. Botany · Plants. General culture: Soil, seed plots, plantations. Special cultures: Alimentary, textile, oleaginous, tinctorial, industrial, etc. Rural economy: System of culture, varied succession of crops, leasing of farms. Agricultural industries (beer, sugar, wine, alcohol, milk, butter, etc.). Ideas concerning zootechnics and agricultural chemistry.

Colonial Hygiene.—Dwelling, garments, alimentation. Tropical diseases: Malaria, dysentery, hepatitis, etc. First-aid in case of accident or sickness.

33. *Languages.*—The scheme embraces instruction in the following elements, viz.:—

Dutch, English, Spanish, Italian, German, Portuguese.

Commercial, industrial, financial and economic relations. Models and redaction of civil and commercial documents. Conversation. Study of the principal contemporary authors, publicists, and economists.

Russian.—(Lower section in the second year). Pronunciation, reading, grammar, dictation, exercises and translations, epistolary and commercial style, exercises, etc. (Higher section in the third year).—Style in general. Commercial letters. Usual forms. Translation of several authors.

Chinese and Congo commercial language.

34. *Preparatory Course.*—The Institute provides a preparatory course, covering also the subjects of the entrance examination. This course was specially designed to facilitate the entry of foreign students, that they might be adequately prepared for the normal instruction of the Institute. Belgian students who have attended the courses of a State institution, are not admitted unless they have left it more than six months before their registration at the preparatory course.

It begins each year a week after Easter, and terminates on the 31st July.

It is given by the masters and the professors of languages of the Institute, and includes the following subjects, viz.:—French, 3 hours per week; German, 3 hours; English, 2 hours; history, 3 hours; geography, 2 hours; book-keeping, 3 hours; arithmetic, 3 hours; algebra, 2 hours; geometry, 2 hours; physics, 2 hours; chemistry, 2 hours; law, 2 hours; political economy, 1 hour.

The cost of registration is from 100 francs (£4), payable in advance. The examination of the pupils of the first year takes place annually, early in October, before a committee of professors of the Institute, the athenæums, colleges, and other institutions, appointed by the Government. The registration fee is 25 francs (£1). Diplomas and certificates are previously forwarded to the Director.

35. *Details of Preparatory Course.*—The programme of the preparatory course is developed as follows:—

(I) *Language courses:*—
- (1) *French Language.*—Grammar. Syntax. Composition. Correspondence.
- (2) German } Grammar. Syntax. Translation. Redaction.
- (3) English }

(II) *Book-keeping:*—
Book-keeping. Principal books. Auxiliary books. Invoices. Bills. Bills of lading. Bills of exchange. Legal conditions of commercial practice. Study of accounts of various kinds, viz., merchants, bankers, traders, consignees, companies. Accounts current and interest. Exchange operations: public funds and bullion.

(III) *Geography:*—
The physical geography of the five continents of the world.

(IV) *Mathematics:*—
- (1) Arithmetic.—Elementary arithmetic, with its applications to commerce.
- (2) Algebra.—Algebraical calculations. Equations of the first degree to one and more unknowns. Equations of the second degree to one unknown. Problems and discussion of their solutions.
- (3) Geometry.—Plane geometry. The four first books of Legendre, annotated by Blanchet.

(V) *Elementary Conceptions of Physics and Chemistry:*—
- (1) *Physics:*—
  Preliminary ideas. General properties of bodies. Weight. Hydrostatics. Specific weights. Gases. Principles of acoustics, heat, light, magnetism, and electricity.
- (2.) *Chemistry:*—
  Inorganic: Preliminary ideas. Chemical nomenclature. Atomic theory. Symbols and formulæ. Laws of simple proportions. Laws of multiple proportions. Problems of application. Syntheses, Analyses. Reactions. Berthollet's laws. Solution. Crystallisation. Radicles. Theory of types. Metalloids and their compounds. General characters of oxides, sulphides, chlorides, bromides, iodides, fluorides, and oxysalts.
  Organic: Some ideas concerning organic chemistry.

(VI) *Universal History:*—The Universal History is divided into ten periods, viz.:—
First Period.—History of the primitive races of antiquity to the beginning of the Peloponnesian War. (431 B.C.)
Second Period.—From the beginning of the Peloponnesian War to the reduction of Greece to a Roman province. (145 B.C.)
Third Period.—From the beginning of the History of Rome to the civil war, exclusively. (91 B.C.)
Fourth Period.—From the civil war to the death of Augustus. (14 B.C.)
Fifith Period.—From the death of Augustus to the fall of the Roman Empire in the West. (476.)
Sixth Period.—From the fall of the Western Roman Empire to the death of Charlemagne. (814.)

Seventh

Seventh Period.—From the death of Charlemagne to the removal of the Holy See to Avignon. (1309.)

Eighth Period.—From the removal of the Holy See to Avignon to the Peace of Westphalia. (1648.)

Ninth Period.—From the Peace of Westphalia to the French Revolution of 1789.

Tenth Period.—From the French Revolution to 1830.

The periods of Universal History on which the entrance-examination bears, are fixed annually between October and January by the Director of the Institution.

The ninth and tenth periods have been assigned for the October Examination, 1902.

(VII) *Commercial Law:*—Contracts, essential conditions and principal contracts. Merchants, commercial books, factors and brokers. Bills of Exchange. Invoices, charter-party and bills of lading. Trading companies, failures, and bankruptcies.

(VIII) *Political Economy:*—General ideas according to the treatise of J. Garnier or E. de Laveleye.

36. *Regulations as to Entrance Examination.*—The examinations are written, then oral. The written examination includes:—

(1) A composition in French and a translation from French into English and German. (2) Arithmetic with its applications to commerce and the elements of book-keeping. (3) Physical geography. (4) The principles of universal history. (5) Commercial law. (6) Political economy.

The oral examination includes:—

(1) The elements of algebra and geometry. (2) Elementary ideas of physics and chemistry.

The candidates have six hours for their written work. The oral examination lasts at least half-an-hour for each candidate.

37. *Concluding Remarks.*—The Institute has an extensive building, with a fine museum of woods, minerals, manufactured and raw products, a good chemical laboratory. The equipment, however, was not so perfect as that of the academy at Neuchâtel.

The whole scheme of training is practical, and is developed on broad lines. Commercial men in endeavouring to appreciate the course at its proper worth, will do well to remember that each instructor is a specialist in his own subject, and that there has been keen emulation between the larger Commercial Schools of Europe.

The advantages of so fine a course are obvious. Mere lectures in a university cannot be compared with the courses and practical work in a high school of commerce, and to give a university course that touch with practical commercial life which is necessary in so essentially practical a subject, a commercial bureau and commercial museums and laboratories are required.

CHAPTER LIV.

CHAPTER LIV.

Commercial Education in Austria, Bohemia, France and Germany.

[G H. KNIBBS.]

1. *Introduction.*—The object of this chapter is to give a general indication of the provisions made in Austria, Bohemia, France and Germany for commercial education, without necessarily entering into many details. Later chapters will afford illustrations of the way in which curricula are worked out, and for Germany more complete information will be found in a Chapter by Mr. J. W. Turner.

2. *Commercial Education in Austria; its Extent.*—Considerable provision has been made in Austria for commercial education. The existing types of schools may be divided into (I) higher commercial schools (Höhere Handelsschulen); (II) commercial day schools (Commercielle Tagesschulen) and (III) mercantile continuation schools (Kaufmännische Fortbildungsschulen).

(I.) Under the first heading may be mentioned the commercial academies (Handelsakademien) of Vienna; that of Lenz in Upper Austria; of Gräz in Steiermark; of Trieste; of Innsbruck in the Tyrol; the German and Czechish academies in Prague; the German Academy in Aussig; the Czech Academy in Chrudin, Bohemia; the Commercial High School (Scuola Superiore di Commercio) of Trieste; the Commercial Middle School of Trient, the commercial schools of Königgrätz, of Pilsen, and of Reichenberg in Bohemia; the "Franz-Josef" Higher Commercial School of Brünn and the higher commercial schools of Olmütz and Prossnitz in Moravia (Mähren); the Higher Commercial school of Cracow (Kraków) in Galicia, etc.

(II.) Under the second heading may be mentioned the district commercial schools—Landes-Handelsschule of Krems in Lower Austria; the Communal Commercial School of Wels in Upper Austria; the commercial schools of Klagenfurt in Kärnten; of Bozen in the Tyrol; the Communal Commercial Schools of Brüx, Budweis, Gablonz, Horitz, Melnik, Teplitz, Warnsdorf, in Bohemia; the commercial courses for girls in Mährish-Ostrau, the Commercial School for Girls in Olmütz, both in Mähren; the Commercial School of Troppau, in Silesia; the commercial division of the Staatsgewerbeschule of Czernowitz, in Bukowina; a number of private or semi-private schools in Vienna, Styr, Salzburg, Gräz, Voitsberg, Laibach, Rieden, Prague, Kolin, Pilsen, Saaz, Smichoff, Teplitz, Brünn, Troppau, Lemberg, Sambor, etc.

(III.) Under the third heading may be mentioned Mercantile Continuation Schools, of which there are about 15 in Vienna and its suburbs and immediate surroundings, 5 in Upper Austria, 1 in Salzburg, 6 in Steiermark, 4 in Kärnten, 4 in Krain, 1 in Trieste, 1 in Görz, 3 in the Tyrol, 1 in Vorarlberg, 4 in Prague, and about 61 altogether in Bohemia, 22 in Mähren, 8 in Silesia, 4 in Galicia, 1 in Bukowina.

3. *Courses in Austrian Commercial Schools.*—The different classes of school exhibit some variety of organisation. For example, among the higher commercial schools one finds the following varieties, viz. :—

I. (i) A preparatory course and a general course.
(ii) The same as (i) plus a special course, or a course for women.
(iii) The same as (i) plus an "Arbiturienten" course, or course qualifying for University entrance; and an evening course for women.
(iv) Commercial courses with others.
(v) General courses; a single-year commercial course for graduates of middle schools (*absolvierte Mittelschüler*).

Among the ordinary commercial day schools one also finds the following types, viz. :—

II. (i) A preparatory and general course.
(ii) The same plus a course for women.
(iii) Day and evening courses, with special orientation of the programme.

In the mercantile continuation schools one finds types such as :—

III. (i) Preparatory and definitely organised continuation courses in commerce.
(ii) Free courses, as for example for English, French, secretarial work, etc.
(iii) Organised courses, with specialisation in upper classes.
(iv) Courses in single subjects.
(v) Or thoroughly specialsed courses, as for railway—commerce and railway tariffs, etc.

4.

4. *Statistics of Austrian Commercial Education.*—The languages of instruction are German, Italian, Czech, and Polish. The teaching of languages covers, of course, a much wider range including English, French, Russian, Turkish, etc., besides those above mentioned.

The following statistical table will give an idea of the extent of the provision made for commercial education in Austro-Hungary :—

Type of School.	No. of Schools.	Directors.	Professors, etc.	Assistant Teachers.	Occasional or Special Teachers.	Total No. of Teachers.	Ordinary Pupils.	Special Pupils.	Total Number.
(I) Higher Commercial Schools ...	20	20	183	51	104	358	4,429	155	4,584
(IIa) Public Day Commercial Schools ...	15	14	52	8	46	120	970	14	984
(IIb) Private Commercial Schools ...	35	35	201	25	56	317	5,344	54	5,398
(III) Mercantile Continuation Schools...	135	90[1]	189	261	57	597	11,327	10,351	976
Totals	205	159	625	345	263	1,392	22,070	10,574	11,942

This discloses the fact that the provision for commercial education is very liberal.

It is not necessary to give examples of the programme, throughout. One may take at haphazard one or two.

5. *The Commercial Academy of Aussig, Bohemia.*—The Commercial Academy of Aussig[2] has a higher school of commerce, a commercial course for girls, and a mercantile continuation school (Kaufmännische Fortbildungsschule). Its equipment consists of a library for teachers of about 1300 works (or 2100 volumes), a pupils' library, a collection of material for teaching geography, a cabinet for physical apparatus, a laboratory, a technological museum with a number of raw manufactured products, a museum for natural history, including zoology, botany and mineralogy, a collection of current coins and minor material.

The programme of the Academy is as follows :—

Programme of the Handelsakademië of Aussig, Bohemia.

Subjects.	Years and Hours per week.				
	I.	II.	III.	IV.	TOTALS.
I. *Obligatory subjects.*					
German Language[3] ...	4	2	3	2	11
French and Correspondence ...	5	4	5	5	19
English Language and Corrrespondence ...	...	5	5	6	16
Commercial Arithmetic ...	4	3	3	3	13
General Arithmetic (Algebra, Geometry) ...	3	2	2	...	7
Correspondence and Counting-house practice ...	2	2	3	I. Sem. 4	9
Book-keeping ...	...	2	3	I. Sem. 4	7
Model Counting-house ...	...	..	...	II. Sem. 8	4
Theory of Commerce ...	...	2	...	...	2
Exchange Law ...	...	...	2	..	2
Commercial and Industrial Law ...	...	...	...	2	2
Domestic Economy ...	...	...	...	2	2
Commercial Geography ...	2	2	2	2	8
General and Commercial History ...	2	2	2	2	8
Natural History ...	2	...	...	...	2
Physics ...	3	...	...	...	3
Chemistry and Chemical Technology ...	...	3	2	...	5
Knowledge of Merchandise and Mechanical Technology ...	...	...	2	2	4
Caligraphy and Typewriting ...	3	2	...	...	5
Stenography ...	2	3	...	...	5
Total ...	32	34	34	34	134
II. *Optional subjects.*					
Bohemian (Czech) Language ...	2	2	2	2	8
Laboratory Practice ...	.	..	3	3	6
Gymnastics	2	2	2	2	8

[1] There are not 135 directors because the schools are sometimes annexes of others.

[2] See 16 ter Jahresbericht der Aussiger Handels-Akademie, Aussig, 1902.

[3] The language in which the instruction is given.

6. *Commercial Course for Girls, Aussig.*—There is a rapidly growing demand for commercial education for women in Austria, to meet which commercial courses for girls are greatly multiplied. The course at the Aussig Academy involves 21 hours a week, and consists of the following subjects, viz.:—

Programme of the Handelskurs für Mädchen, Aussig.

Subjects.	Hours per Week.
Commercial Arithmetic	4
Theory of Commerce and Exchange	2
Counting-house Practice and Correspondence	4
Book-keeping	4
Commercial Geography	2
Caligraphy	2
Stenography	3
Total	21

Besides the above in the second semester, instruction in type-writing is introduced, and occupies two hours a week.

7. *The Mercantile Continuation School, Aussig.* There are three classes in this school, the hours per week devoted to the various subjects being shewn in the programme hereunder:—

Programme of the "Kaufmännische Fortbildungsschule," Aussig.

Subjects.	Classes and Hours per Week.			
	I.	II.	III.	Totals.
German Language[1]	2	1	......	3
Geography	1	2	......	3
Arithmetic	2	2	2	6
Book-keeping, Commercial Correspondence and Counting-house Practice.	......	1	4	5
Theory of Commerce and Exchange	......	1	1	2
Caligraphy	2	......	......	2
Total	7	7	7	21

[1] The language in which the instruction is given.

8. *The Commercial Academy of Olmütz.*—By way of illustrating both the similarity and the want of absolute identity in the scheme of commercial education of Austro-Hungary, we may take the very fine School of Olmütz. This is a higher commercial school, the Director[1] of which is the Director of the school of two classes for girls and the mercantile continuation school connected with the Institution. The programme of the higher school is as follows:—

Programme of the "Handelsakademie" at Olmütz.

Subjects.	Years and Hours Per Week.				
	I.	II.	III.	IV.	Totals.
I. *General Obligatory.*					
German Language (as language instruction)	4	3	3	3	13
French Language and Correspondence	6	4	4	4	18
English or Tschechische Language and Correspondence ...	...	6	5	4	15
Commercial Arithmetic	4	4	3	4	15
General Arithmetic, Algebra and Geometry	4	2	2	...	8
Correspondence and Counting-house Practice	2	2	3	I. Sem. 3	$8\frac{1}{2}$
Book-keeping	...	2	3	I. Sem. 3	$6\frac{1}{2}$
Model Counting-house	...	...	...	II. Sem. 6	3
Theory of Commerce	2	...	...	...	2
Exchange Law	...	...	2	...	2
Commercial and Industrial Law	...	...	...	2	2
Domestic Economy	...	...	...	2	2
Commercial Geography	2	2	2	2	8
General and Commercial History	2	2	2	2	8
Natural History	...	...	2	...	2
Physics	3	...	...	...	3
Chemistry and Chemical Technology	...	2	2	2	6
Knowledge of Merchandise and Mechanical Technology ..	...	...	...	3	3
Caligraphy and Typewriting	2	2	...	...	4
Stenography	2	2	...	...	4
	33	33	33	34	133
II. *Optional.*					
Practical Exercises in the Chemical Laboratory	...	3	3	3	9
Practical Exercises in the Laboratory for the Testing of Merchandise	...	...	...	3	3
Gymnastics	2	2	2	2	8

It will be seen on comparison with the Aussig Academy that while the subjects are identical the distribution of time is different.

9.

[1] It may be incidentally mentioned that the Director teaches 6 hours per week.

9. *Commercial School for Girls, Olmütz*:—The commercial school of two classes for girls has only recently been opened and started with a pupilage of between 40 and 50.

The programme of the mercantile continuation school is as follows :—

Programme of the "Kaufmännischen Fortbildungsschule in Olmütz:

Subject.	Hours per Week.		
	I.	II.	III.
German...	2	...	...
Arithmetic	2	2	1
Book-keeping	...	1	2
Commercial Correspondence	...	1	1
Commerce and Exchange	...	...	1
Geography	1	1	1
Caligraphy	1	1	...
Totals	6	6	6

The above will be sufficient to shew the independence of the different institutions of Austro-Hungary.

Commercial Education in France.—The provision made in France for commercial education is very extensive. Among other places there are "practical and higher schools of commerce. (*écoles pratiques de commerce*, *écoles des hautes études commerciales*, *écoles supérieures de commerce*, *instituts commercial*, *etc.*) for boys, girls, and young men and young women at Narbonne, Marseilles, Romans, Brest, Nîmes, Bordeaux, Montpellier, Béziers, Cette, Grenoble, Nantes, Agen, Rheims, Nancy, Lille, Fourmies, Boulogne-sur-mer, Lyons, Le Mans, Paris, Rouen, Le Havre, Mazamet, Limoges, etc. There are also commercial courses for adults at various places.

The first commercial school in Paris, established in 1820, was initially both commercial and industrial, but two years later became wholly commercial. It was acquired in 1868 by the Paris Chamber of Commerce, and is now an "*Ecole Supérieure de Commerce.*"

The technical schools of France are under the Ministry of Commerce and Industry (*Ministère du Commerce, de l'Industrie, des Postes des Télégraphes*), and the general organisation is very similar to the organisation of secondary education described in Chap. XIII, pp. 142-7, of the Commissioners' Report on Secondary Education. A "*Conseil supérieur*" decides all questions referring to technical education. The President of this Council is the Minister (*Ministre*) of Commerce and Industry. It has 49 members. The Ministry has an internal trade and technical instruction department, the chief of which is a prominent member of the Council. Presidents of the Chambers of Commerce, Directors and Professors of superior commercial schools and practical industrial and commercial schools, and merchants and manufacturers are represented on the Council, which, therefore, is widely representative. Sixteen members of the Council are constituted a permanent commission for technical education, and all commercial schools which are either maintained, subsidised, or officially recognised by the State, are under the Inspector-General of Technical Education.

11. *Elementary Commercial Education, France.*—Primary, industrial and commercial schools under "departmental" control, or under communal and State supervision, are scattered throughout France. The supervision of these, at one time under the Ministry of Public Instruction and Commerce and Industry conjointly, was transferred in 1892 to the latter alone. Instruction in these elementary schools is gratuitous, and pupils to enter them must be at least 12 years of age, and possess the elementary education certificate. At 13, however, this certificate is not necessary, provided an entrance examination can be passed. Most of the tuition is in the day-time, though this is not invariable. Some reference is incidentally made in Chap. X of the Commissioners' Interim Report on Primary Education to the lower forms of commercial education.

The direct supervision of elementary commercial education is in the hands of a "*Conseil de Perfectionnement*," the President of which is the Prefect. The other members are the Inspector of Commercial Instruction in the district (an honorary office), four members nominated by the General or Municipal Council, and a member appointed by the Minister of Commerce and Industry.

This Council pays a monthly visit to the school, considers the Inspector's report in regard to expenditure and the school's general condition, is present at the final examination, and endeavours to find employment for pupils at the end of their studies—those passing well having, of course, the preference.

The School Directors, though in attendance at the deliberations of this Council, have no vote. On the basis of a general schedule issued by the Ministry, the programme of each school is arranged by the Council, and directions are issued to the teachers as regards the generalities of the teaching-method and the points on which it is desired that special stress should be laid.

The

The course is of three years' duration, and the hours per week are as follow, viz.:—

	Boys.			Girls.		
	Year I.	Year II.	Year III.	Year I.	Year II.	Year III.
General subjects	23	18	15	16½	18	16½
Commercial subjects	16	22½	27	16½	18	22½
Totals	39	40½	42	33	36	39

The lessons last 1½ hours each.

The curriculum for boys usually embraces commerce and book-keeping, a foreign language, arithmetic, algebra, geometry, geography, caligraphy, chemistry, merchandise, common and commercial law, economics, French, drawing, history, natural history and hygiene, and elementary physics. The curriculum for girls is much the same, but embraces in addition domestic economy, sewing, cutting-out and ethics.

Girls' Practical School of Commerce and Industry, Nantes.—By way of illustration one may take the prospectus of the *Ecole Pratique de Commerce et d' Industrie pour les jeunes filles à Nantes.* The course is divided into two branches, viz., a commercial section and an industrial section, each with three years; and in addition there is a preparatory course. The commercial section is divided into the *commercial* and *general* branches of instruction as follows :—

Commercial Branches :—Commerce, accountancy, book-keeping, English, applied arithmetic, applied algebra, geography, chemistry, civil legislation, commercial legislation, commercial economy, writing, "*steno-dactylographie.*"

General Branches :—Ethics, French (viz., grammar, orthography, composition, reading and recitation, literature) history, physics, natural history, hygiene, geometry, drawing, domestic economy, ordinary sewing and cutting-out, etc.

The teaching staff consists of lady teachers ("*professeurs*") possessing the "*Certificat d'aptitude au professorat commercial,*" of assistant mistresses (*maîtresses-adjointes*) possessing the "*brevet supérieur,*" and of auxiliary masters and mistresses (*maîtres et maîtresses*) for special branches of instruction such as drawing, English, domestic economy, and so on.

Not only is the instruction wholly gratuitous, but girls not belonging to the city, living at a "*internat*" approved by the State, may also avail themselves of the instruction. Arrangements are made for lunch to be taken at the school for those who so desire. Each year a certain number of bursaries are provided and pupils are placed in a pensionnat approved by the State so that they may follow the courses in the school.

The final examination consist of written and oral tests. The written work includes a French essay, questions upon the theory of book-keeping, and upon commercial legislation, and arithmetic; the writing of a letter in English; and the translation of an English letter into French, in both cases without the aid of a dictionary. The practical test consists of entries relating to commercial transactions, the mode of dealing with documents bearing upon these, the making up of a current account by one of the ordinary methods. The oral tests bear upon the portion of the curriculum not included in the written work, but in the foreign language oral translation and also conversation are included.

13. *Directors and Teachers.*—Directors for these elementary commercial schools are appointed after competitive examinations, and they must be 25 years of age, have been five years in a practical commercial school, and have spent two years there as teachers (*professeurs*).

The teachers (*professeurs*) must be 21 years of age, and must have taught in a public or private school for at least two years. They undergo an examination including in the first part matters of commercial interest, shorthand and typewriting as optional subjects, and are examined in either English, German, or Spanish. Successful candidates are entitled to a travelling-exhibition. Within a month they are required to leave France, go to a town assigned to them in England, Germany, or Spain, according to the language taken, and are expected to stay there about eleven months. They report fortnightly in the language of the country in which they are residing and on return pass a final examination.

14. *Other elementary commercial instruction :*—Superior primary professional schools, though mostly industrial, have occasionally distinct commercial sections, and all give commercial instruction of at least a rudimentary character.

There are also a number of schools not under Government supervision supplying commercial education. These are not gratuitous, some charging an annual fee of about £9, as for example, the school in the Avenue Trudaine, Paris, founded in 1863 by the Paris Chamber of Commerce. The diplomas and certificates issued by that important body ensure pupils possessing a certainty in finding employment.

There are some features in the curriculum of this Paris school worthy of special mention. History and geography are commercially orientated; special attention is paid to mental arithmetic, to rapid methods of calculation, and to rapidity of calculation. In the ordinary course three modern languages are obligatory, English and German through the whole four years, the former only being taught in the preparatory courses; Spanish and Italian are taught during the last two years. In the four years the hours of study are 28, 28, 30, and 34 per week, and they are 26 per week in the preparatory school.

15.

15. *Exhibitions or Scholarships.*—Youths between 16 and 18 years of age who have spent two full years at the practical commercial school or a superior primary professional school, or at the commercial school in Paris, or who have spent a year at the preparatory section of a higher commercial school and who are candidates for the travelling scholarship, are awarded 10 per cent. marks in the examination, while one year in a business house or industrial undertaking entitles them to 5 per cent. of the total marks. The examination is competitive, and successful candidates receive £160 for the first year, and £120 for the second; and, if they are of exceptional ability, £120 for the third. They are exempted from military service up to 30 if they reside out of France, and during the tenure of their scholarship are under the supervision of the Consul in the locality where they reside.

16. *Higher Commercial Education, France.*—There are a considerable number of *écoles supérieures de commerce* in France; for example, the higher commercial schools of Marseilles, Bordeaux, Lyons, Paris, Le Havre, Lille, Rouen, Nancy, Montpellier, the *Ecole des hautes études commerciales*, and the *Institut Commercial* of Paris. In 1889 these obtained semi-official recognition by the Government, though one of them had existed since 1820.

The effect of this State recognition is to relieve the first four-fifths of those who pass the final examinations of two out of the three years compulsory military service. Graduates of the school may become consular clerks "*élèves-chanceliers*" and those who possess the "*bachelier*" may complete for consular and diplomatic posts. The details of the organisation and curricula of the higher schools of commerce of Lille and Marseilles will give sufficient indication of the type of instruction given, and the general organisation of the school

17. *Criticism on the work of the Higher Commercial School.*—The programme of the Higher Commercial School, as will be seen from chapters dealing therewith is very extensive. Considerable variety of opinion exists as to the wisdom of this. It is admitted on all hands that commercial education of such thoroughness and breadth will establish a commercial *corps d'élite.* In some respects the education is unnecessarily advanced for ordinary commercial clerks, in fact it is hardly designed for such. Again, its breadth operates somewhat against intensity of specialisation, which has some value, and a student, in general, has not the privilege of limiting his attention to a particular set of studies. At Lyons, however, this statement requires modification, as there is some specialisation with regard to the silk industries, and at Marseilles there is another type of specialisation which may be observed by reference to the details of the curriculum.

Despite the fact that young men turned out from these establishments lack experience, and perhaps for a time that facility which comes therefrom, the width of their view, and the thoroughness of their theoretical knowledge, has been found such as to justify the placing of them in responsible positions at a far earlier age than is possible in the case of those whose progress is by gradations through the routine of office work. This is in accord with general experience in all forms of higher education, and clearly supports the general evidence that intellectual culture which does not betray early anxiety about specialisation, confers great practical advantages.

The above will give a general idea of the system of commercial education in France.

18. *Commercial Education in Germany.*—Commercial education in Germany shews some variety of organisation in its different kingdoms. If one compares, for example, the programme of the Handelsschule in Berlin (90 Dresdenerstrasse) with the Handelsschule of Cologne, it is at once obvious that there are differences in the programme. The same remarks apply to the Handelshochschulen of, say, Cologne and Leipzig.

It may be mentioned that some of the teachers in the German High School are men of considerable eminence. One might mention, for example, the late Professor Dr. Ratzel, of Leipzig, whom the Commissioners had the honour to meet. Dr. Ratzel's lectures in the Commercial High School covered general geography, the countries and peoples of Europe, with special regard to their political and economic relationships, general hydrography, scientific ethnography, and commercial geography.

The equipments in these schools, especially those for the examination of commercial products, the chemical laboratories, the museums of raw and manufactured products, and the counting-house equipment, were remarkably good in each school seen by the Commissioners in Germany, and the elaboration to secure efficiency was obvious.[1]

For further information reference may be made to another chapter, dealing with details.

---

[1]That the charges for electricity for the Higher Commercial School of Cologne amount, it is said, to £200 per annum, is some slight indication of the extent of the institution.

CHAPTER LV.

CHAPTER LV.

The Higher School of Commerce of Lille, France.

[G. H. KNIBBS.]

1. *Introduction.*—The Higher School of Commerce of Lille (*Ecole Supérieure de Commerce de Lille*) is one of the distinguished commercial schools of France. An account of its organisation and courses is consequently given in detail. These represent the ideas of Northern France as to the most desirable form of higher commercial education. In the next chapter the Marseilles school will be taken as giving an example of the views obtaining in Southern France, and these two chapters taken together will be a sufficient indication of French ideas of higher commercial education.

2. *Aim of the School.*—The school was founded in 1892, by the Lille Chamber of Commerce, for the purpose of giving useful technical instruction to youths who are desirous of entering upon the higher commercial careers. "Situated, both in an industrial and a commercial sense, in the most stirring district of France and in a university centre of unique importance and remarkably well equipped, it presents exceptionally favourable conditions for giving practical instruction, which shall at the same time be in conformity with scientific progress," so affirms justly, its official programme, from which the following information is derived.

The studies of the normal courses relate to commerce and accountancy (seven lessons per week for each year); mathematics applied to commerce; merchandise and organic chemistry; transports and industrial plant (ways of communication and tariffs, navigation, industrial management, lighting, etc.); two modern languages (English obligatory, German, or Spanish); legislation and political economy; economic geography; economic history (particularly contempory history); commercial correspondence and caligraphy. *There is a special course in the manufacture and commerce of textile fabrics.* Type-writing machines are at the disposal of pupils who desire to learn "Dactylography." Particular attention is given to instruction in the modern languages which is essentially practical; conversational classes, consisting of small groups, have been formed and are said to give eminent satisfaction.

Lectures on *Brewery* are given in the premises of the "*Institut Pasteur,*" generously permitted for that purpose by the Director of the Institute.

As a result of its enlargement in 1900, the school now possesses special libraries and a commercial museum, where the pupils may work at stated hours.

Visits are made to the various works of the district, under the direction of competent professors. It is said that the number of students of the Chamber of Commerce, who are successful competitors at examinations for Government positions, has rapidly increased, and the facility with which students of the school find lucrative employment, testifies to the practical value of the Institution, and the public favour with which it is regarded.

3. *Advantages of the School.*—The French and foreign pupils who have obtained 65 per cent. of the total possible marks obtainable during the school-course receive, on leaving, a *higher diploma*, presented by the Minister of Commerce. This document confers on them the privilege of presenting themselves at the competitions instituted in certain ministeries, viz., Foreign Affairs, Colonial, Trade and Industry.

A *Certificat d'études*, is granted to the French and foreign pupils, who are not provided with the higher diploma, provided they have gained at least 55 per cent. of the total possible marks obtainable during the school-course. The possession of either the higher diploma, or the "*Certificat d'études,*" readily obtains for pupils positions in large mercantile establishments, in agency offices, and in industrial and credit establishments.

The higher diploma delivered to the French pupils of the first four-fifths of those who have obtained at least 65 per cent. of the total possible marks (obtainable during the school-course), bears a special mention which confers the right of exemption from two years' military service.

This diploma is called the Higher Diploma, Model (A). That conferred on pupils of the last fifth is known as the *Higher Diploma*, *Model* (*B*).

Candidates admitted to the competitive examination who, by reason of their age, may be summoned to serve their country, during the course of their studies, are consequently obliged to render military service of one year before entering the school. They notify their admission to the military authorities *before* entering upon their duties, and are then conditionally released after one year's regimental service.

One of the great advantages throughout Europe is the reduction of military service in the event of reaching a certain standard of education.

In certain cases pupils are recommended to repeat their studies so as to obtain a satisfactory diploma.

The Commercial School prepares its pupils for commercial careers, proper—for industries, for banking business, etc., for the consular and administrative services, for certain types of teaching (*certificat d'aptitude au professorat commercial*), for the colonial service; and further for bursaries which enable pupils to travel.

More

More particularly, studentship of the school confers the following advantages, viz. :—

Pupils of the school who hold its diploma and who possess also the degree of Bachelor of a University are allowed to compete for the diplomatic and consular careers.

An examination is held annually in December for the vacant offices of attaché of an embassy, of vice-consul, and of paid attaché. The diplomaed pupils may be admitted to the consulates in a lower capacity without examination and without the diploma of bachelor.

Candidates who possess the Diploma of the School may compete for the office of *clerk*, and of Commissary-controller of Insurance Societies against accidents at work, under the Ministry of Commerce and Industry.

Candidates for employment in the administration of the Customs are allowed a sixth of the total marks if they possess the diploma of the Higher School of Commerce.

Candidates provided with the Diploma may present themselves for examination for the office of Colonial Administrator.

The instruction of the School qualifies pupils to compete at the examinations which admit to the Ministry of Finance, the Ministry of War, the Bank of France, to the "*Crédit Foncier.*"

The curricula of the School include all the subjects required for the following examinations, viz. :—

(a) "*Certificat d'aptitude*" for the Teaching of Accountancy, Ministry of Public Instruction.
(b) "*Certificat d'aptitude*" for a commercial Professorship, Ministry of Commerce and Industry.

The diploma and the "*certificat d'études* delivered by the School are equal to the *Baccalaureat* for admission to the *Colonial School* (*école coloniale*). A *commercial section* having been established therein, the pupils of the higher school of commerce, provided with the diploma or the "*certificat d'études*," are eligible to follow the courses of the section. The studies are limited to one year, and pupils who pass the Leaving Examination receive a special "*brevet.*" The physical and military exercises are not obligatory.

Travelling Scholarships.—Pupils provided with the Diploma (A), Diploma (B), or the "*certificat d'études*" are eligible for the annual competitive examination instituted by the Ministry of Commerce, for travelling scholarships, varying from 2,000 to 4,000 francs, say £80 to £160.

4. *Régime of the School.*—The duration of "*scolarité*" of the normal courses is two years. The pupils are allowed, however, under certain conditions, to repeat the first and second year. All the pupils are day scholars.

The time during the day being exclusively devoted to the hearing of the courses, and to exercises in the modern languages and caligraphy, the pupils are obliged to work steadily at home at the recapitulation of their notes, the redaction of exercises which may be given them, and also by way of a preparation of their examinations. Five hours per day are devoted to the normal courses and six hours, and five hours, on Thursday and Saturday, to the preparatory courses.

The Northern Railway Companies grant season-tickets to pupils at half price. Pupils who do not return each evening to the parental home, get suitable lodging at Lille, or in the suburbs of Lille. At the Secretary's office the addresses of respectable houses where the pupils may reside are kept, and they are under more or less strict supervision, according to the desire of their families. Complete *internats* have been organised for the pupils of the School.

Strict discipline is maintained. Every absence from school must be justified by a letter from the family or the responsible person. Reports giving information as to the work and the conduct of the pupils are sent at the end of every quarter in the normal courses, and every month in the preparatory courses.

5. *Fees.*—The fee is 700 francs (£28) per year, for each of the two normal years, and for the preparatory year, and is paid one-third at entrance, one-third on the 1st January, and the balance at Easter, and every trimester[1] entered upon must be paid for, whether the pupil continues to attend or not.

Apart from the school-fee, pupils pay on the first term of each year a sum of 20 francs (16s.) for laboratory purposes, and also for any school material.

Diplomas of the Higher Schools of Commerce recognised by the State can only be delivered to the parties concerned, after the payment, into the Public Treasury, of a sum of 100 francs (£4).

6. *Qualification for Entrance.*—The following views as to what are considered the best forms of preparation for entrance to the Higher School of Commerce are of interest, and throw some light on the French view of the practical value of different forms of education for commercial life. They are therefore, given in the form of a table :—

Table shewing grades of preparation for entrance examination to Lille Higher School of Commerce.

I. Best form of preparation.

(1) Preparatory course connected with the school itself.
(2) Success in special courses of preparation, specially instituted in various private or official secondary schools.
Head-masters and Principals in the "*Académie*" of Lille, in conformity with the instructions of the Rector, are requested to establish special preparatory courses in their institutions. An arrangement should be made with the parents in this regard. Courses of this character already exist in the *lycées* of Lille, Douai, Valenciennes, Charleville, and Amiens.
(3) Preparatory courses in the large Government schools (Polytechnique, Centrale, Saint-Cyr, Navale).
(4) Pupils of higher course of elementary mathematics.
(5) *Bacheliers de lettres-sciences et lettres-mathématiques.*

II. Well-prepared.

(1) "*Bacheliers*" of classic division (*lettres-mathématique*).
(2) "*Bacheliers*" of classic and modern division (*lettres-philosophie*).
(3) Pupils in *Première-Sciences* in modern division.
(4) Pupils in *mathématiques-élémentaires*.

III. Sufficiently or partially prepared.

(1) Pupils in *Philosophie* and in *Première-Lettres.*
(2) Pupils of the Second Class of modern division.
(3) Pupils of "*Rhetorique.*"
(4) The simple "*brevet*" or the higher primary "*certificat d'études.*"

The *Baccalauréat* does not confer any advantage in the way of marks at the entrance-examination.

7.

[1] A trimester is one-third of a year.

7. *Preparatory Course in the Higher School of Commerce.*—The preparatory school of one year prepares for the normal school, about 80 per cent. of the pupils passing. Admission depends upon the Director's decision as to whether the pupil is able to advantageously follow the course. This is based upon a summary entrance examination on French grammar, elementary arithmetic, plane geometry, general geography.

Entrance is by competitive examination, since the number of pupils which may be received is limited. For example, in 1902 only sixty-five pupils could be admitted to the first year.

8. *Entrance Examination.*—The scheme of the examination is as hereunder: it discloses the relative value of various subjects—from the point of view of the French authorities—for the purpose of a course in Commerce:—

(1) *Written Examination.*

	Coefficient.	Totals.
Mathematics.—Questions in Arithmetic	3	8
,, Algebra	4	
,, Geometry	1	
French.—Redaction	3	5
Orthography	1	
Writing	1	
Modern Languages.[1]—Exercise	3	4
Translation	1	
Geography	...	4
Total for the written tests	...	21

(2) *Oral Examination.*

	Coefficient.	Totals.
Arithmetic	...	4
Physics	1	3
Chemistry	2	
History	...	1
Modern Language (explanation of a passage and conversational exercise)	...	4
Total	...	12

Marks are assigned as follows:—

0, nothing; 1, 2, very bad; 3, 4, 5, bad; 6, 7, 8, mediocre; 9, 10, 11, fair; 12, 13, 14, very fair; 15, 16, good; 17, 18, 19, very good; 20, perfect.

The maximum of points to be obtained is thus,—$(21+12) \times 20 = 660$ points.

The candidate may select for the written and oral examination in a modern language, English, German, or Spanish.

Those who get less than 50 per cent. are not received. If more than the available number pass, the order of passing determines the reception.

No distinction is made between foreign and French candidates, but the diplomas of the foreign candidates indicate their nationality.

Subject to Ministerial sanction, the Director of the School may admit both French and foreign pupils as irregular students, who follow the courses without, however, submitting to examination. They cannot obtain either diploma or certificate, but may receive an attestation of having attended the course.

Applicants must submit to the Director of the School the following documents, viz:—

(1) A request on stamped paper (0 fr. 60 c.) as hereunder:—

Monsieur the Director,

In conformity with art. 2 of the decree of 11th June, 1898, I have the honour to apply for permission to follow, in capacity of auditor, the courses of the Higher Commercial School of Lille. Born the... .... at ....in proof whereof, I enclose my birth certificate, I am of nationality......................, I have previously studied at..........., and I also enclose the certificate of this institution.

(Signed)...................... ..

(2) A birth certificate on stamped paper and authenticated.

(3) A certificate of good conduct, delivered by the principal of the last institution attended.

9. *Bursaries.*—The State, the Lille Chamber of Commerce, the *Conseil-général du Nord*, the Municipality of Lille, and various other Municipalities and Chambers of Commerce of the district have endowed the Higher Commercial School with a certain number of Bursaries, for the obtaining of which the candidates must comply with certain articles of the *arrêté* of 23rd March, 1899. The drift of these is that the financial limitations of the applicant's family is a determining factor, that the nationality must be French, the age at least 16. The State bursaries are the most general.

The bursaries of the "*Département*" and of the city of Lille are reserved to pupils residing in the *Département du Nord* and that city.

Other municipalities and Chambers of Commerce have accorded bursaries to deserving youths residing in their special "*circonscriptions*."

10. *Detailed programme of preliminary knowledge required.—Arithmetic:* The following defines the requirements in the way of preliminary knowledge, and is given with a view of clearly indicating the grade of education attempted in the Higher School of Commerce. The programme is, as usual, quite definite, and does not leave the candidate in the uncertainty characteristic of an examination, *through lack of clear specification.*

The first subject considered will be arithmetic.

Arithmetic.

Preliminary definitions.—Magnitudes, numbers, measurement of a magnitude, units, whole number, fraction, fractional number.

Numeration.—Definitions, decimal numeration.

Notation.—Definitions, absolute value of a figure, relative value.

Operations of whole numbers.—Addition and subtraction. Definitions, rules, proofs; exercises in rapid calculation, mental and written exercises of addition and subtraction. Multiplication. Definitions. Multiplication table up to 15. Various examples of multiplication: theories and practical rules. Theorems relative to multiplication. Division. Definitions. Rules. Exercises. Theorems relative to division. Division by 25, 75, 125, their multiples and sub-multiples. *Properties*

[1] The use of a dictionary is permitted.

Properties of whole numbers. Divisibility.—Preliminary theorems. Remainder of the division of a number by 2, 3, 5, 9, 11, 4 and 25. Proofs by 9 and 11 of multiplication and division. Exercises.
The Greatest Common Measure. Definition. Finding the G. C. M. of two numbers. Fundamental theorems. Rule. Simplification. Exercises. Property of the G. C. M. The G. C. M. of several numbers.
Prime Numbers. Definitions of prime numbers and numbers prime to one another. Theorems. Construction of a table of prime numbers. Resolution of a number into its prime factors. Rule. Exercises. Divisors of a number. Methods for finding them. The G. C. M. The least common multiple (L. C. M.)
Fractions.—Definition. Reduction of fractions to their most simple expression. Reduction to the same denominator. Operations concerning fractions. Exercises. Decimal fractions. Definitions. Numeration of decimal numbers. Operations concerning decimal fractions. Evaluation of a quotient to less than a given decimal unit. Conversion of vulgar fractions into decimal fractions and *vice versa*. Irreducible vulgar fractions giving rise to a recurring decimal fraction. Recurring fractions. Definitions. Examination of generating fractions.
Powers and Roots.—Definitions and Theorems. Extraction of the square root of a whole number. Extraction of the square root of a whole or fractional number with a given approximation. Square root of decimal numbers. Squares and square roots of fractions. Definitions.
Measures.—Ancient French and present legal measures. Comparison. Conversion of old and present measures, and *vice versa*. Measures of length, circumference, volume, capacity, weight, monetary measures. Foreign coins.
Complex Numbers.—Definitions. Operations with complex numbers.
Ratios.—Definitions. Proportions. Proportional magnitudes. Theorems. Application. Proportion (direct, inverse, simple, compound). Method of reduction to unity. Simple questions concerning proportional parts, alligations and mixtures. Rule of simple interest. General formulæ. Application of rapid calculations to the usual rates. Definition of compound interest. Foreign discount. Partnerships.

11. *Algebra.*—The preliminary knowledge in Algebra must cover the following range, viz.:—

Algebraic Calculation.—Employment of letters and signs as means of abbreviation and generalisation. Similar terms. Addition and subtraction. Multiplication. Rule of signs. Division of monomials. Division of polynomials. Introduction and calculation of negative numbers. Negative exponents. Fractional exponents.
Equation of the 1st degree with one unknown.—Resolution of a system of two equations of the 1st degree with two unknowns; of a system of three equations of the 1st degree with three unknowns. Summarised statement of the method of resolution, by the employment of indeterminate factors, of any number of equations whatsoever of the 1st degree, including a like number of unknowns.
Problems of the 1st degree. Interpretation of negative solutions.
Equations of the 2nd degree with one unknown.—Resolution of the equation $ax^2+bx+c=0$. Discussion. Imaginary roots. Decomposition of the trinomial ax^2+bx+c into a product of factors of the 1st degree.
Arithmetical and Geometrical Progressions.—Complete theory of progressions. Sum of the first n terms. Limit of the sum of the terms of a descending geometrical progression. Theory of logarithms deduced from progressions. Logarithms whose base is 10. Tables. Index. Introduction of negative indices for extending logarithmic calculations to numbers less than unity. Use of the tables. Extraction of a square root, of a cube root, of a root of any indices whatsoever.
Compound Interest and Annuities.—Application of logarithms to these questions.

12. *Geometry.*—The preliminary demand in Geometry is as hereunder indicated:—

The straight line.—Perpendicular, oblique, and parallel lines.
Angles.—Triangles. Polygons.
Circumference.—Measurement of angles, arcs, and chords. Circle. Tangents and secants to the circle.
Proportional Lines.—Similitude. Regular polygons. Measurement of the perimeter.
Measurement of plane surfaces.—Triangles, quadrilaterals, polygons, circle, sector of a circle, segment.
Measurement of the surface and volume of the principal solid bodies.—Prisms.
Parallelepiped. Pyramid. Frustrum of pyramid. Cylinder. Cone. Truncated cone. Sphere. Surface of a zone. Volume of a segment of a sphere.
Practical Applications.—Capacity of casks. Volume of a heap of sand, etc.

13. *Chemistry.*—The preliminary knowledge in Chemistry must embrace the following:—

General Chemistry.—Simple and compound bodies. Various states of matter. Solution. Crystallisation, Isomerism. Allotropy. Chemical combination. Characteristics of combinations. Law of Mass. Law of definite proportions. Laws of multiple proportions. Laws of Gay-Lussac. Laws of proportionality. Proportional numbers. Atomic weights. Molecular weights. Molecular volume.
Valency of the elements. Chemical nomenclature. Atomic notation. Exclusive usage of atomic notation.
Summary ideas of thermo-chemistry. Summary ideas concerning dissociation.
Metalloids and metals.
Actual classification of metalloids.
Hydrogen.—Preparation. Properties and uses.
Fluorine.—Hydrofluoric acid. Glass engraving.
Chlorine.—Preparations, properties, and uses. Decolouring chlorides. Bleaching. Hydrochloric acid. "Aqua regia" (nitro-hydrochloric acid) sea-salt. Summary ideas concerning bromide and iodine.
Oxygen.—Its preparation, properties, and uses. Combustion. Metallic oxides. Ozone.
Water—Composition of water. Its properties. Natural waters. Potable waters. Mineral waters.
Sulphur.—Extraction, properties, and uses. Sulphurous anhydride. Disinfection by sulphurous anhydride. Nordhausen's sulphuric acid. Ordinary sulphuric acid. Hydrosulphuric acid.
Nitrogen.—Its preparation and properties. Atmospheric air. Composition of air.
Ammonia.—Natural circumstances of production. Industrial preparation of ammonia for commerce and ammoniacal salts. Ammoniacal salts. Properties of ammoniacal gas and ordinary ammonia. Uses of ammonia.
Oxygen compounds of nitrogen.—Protoxide and dioxide of nitrogen. Nitrogen peroxide. Fuming nitric acid. Commercial nitric acid. Nitrification.
Phosphorus.—Physical and chemical properties. Red phosphorus. Uses of phosphorus. Summary of ideas concerning phosphuretted hydrogen. Phosphoric anhydride. Phosphoric acid. Common phosphates. Summary of ideas concerning pyrophosphoric acid and metaphosphoric acid. Industrial preparation of phosphorus.
Arsenic.—Preparation and properties. Arsenious anhydride. Arseniuretted hydrogen. Marsh's apparatus.
Boric acid.
Silica and Silicates.
Carbon.—Examination of its various varieties. Carbonic oxide and carbonic anhydride. Confined air. Common carbonates. Methane. Petroleums. Ethylenes. Acetylene. Benzene. Gas for illuminating purposes. Flame. Carbon disulphide and sulpho-carbonates.
Cyanogen.—Cyanhydric acid.
Metals in general.—General properties. Alloys. Metallic hydrates. Potassium, sodium. Lime and mortar.
Metallurgy of Iron.—Irons, cast-iron and steel.
Salts.—Their general properties. Laws of Berthollet. Saltpetre. Potashes and sodas of commerce. Gypsum. Sulphate of copper. Sulphate of iron. Alums. Clays.
General ideas concerning the common metals.—Iron. Copper. Lead. Zinc. Tin. Nickel. Aluminium. Mercury. Silver. Gold. Platinum.

14. *Physics.*—The preliminary knowledge demanded in Physics is the following, viz.:—

Physical Mechanics.—Uniform motion. Uniformly varied motion. Inertia. Forces in general. Proportionality of forces to accellerations. Mass. Work and *vis viva.* The C. G. S. system.

General physical properties of bodies.—Various physical states of bodies.

Weight.—Direction of gravity. Centre of inertia. Weight. Balance, Double weighing. Specific mass. Specific weight. Density. Laws of the fall of bodies. Atwood's machine. The pendulum and its applications.

Hydrostatics.—Principle of Pascal and its consequences. Free surface of heavy liquids in equilibrium. Pressure on the bottom of vessels. Principle of communicating vessels. Applications. Hydraulic press. Principle of Archimedes. Densities of solids and liquids. Areometers of constant weight. Various graduations. Densimeters. Alcoholometers.

Atmospheric Pressure—Barometers. Mariotte's law. Manometers. Air-pumps, pumps, syphons.

Heat.—Dilatation of bodies by heat. Thermometers. Definition of coefficients of dilatation. Their uses. Action of heat on gases. Normal specific mass of the air. Density of gases in relation to the air. Principle of Archimedes applied to gases. Aerostats.

Specific Heat.—Principle of the method of mixtures. Fusion, solidification. Solution. Refrigerant mixtures. Formation of vapour *in vacuo.* Saturated and non-saturated vapour. Maximum tension. Use of tables. Mixture of gases and vapours. Evaporation, ebullition, distillation. Definition of heat of fusion, and heat of vaporisation. Principle of the steam-engine. Principle of the condenser. Expansion. Power. Ideas concerning the equivalent of the mechanical work of heat. Ideas concerning the conservation of energy.

Hygrometry.—Rain. Snow. Dew. Usual hygrometers.

Magnetism.—Magnets. Poles. Magnetic attractions and repulsions. Declination. Inclination. Declination compass.

Electricity.—General electrical phænomena. Enunciation of the laws of electrical attractions and repulsions. Electrostatic unity of quantity in the C. G. S. system. Experimental ideas concerning potential and electric capacity. Electrostatic units C. G. S. Electrification by influence. Electroscopes. Electrophorus. Electric machines by friction and influence.

Electric Condensation.—Leyden Jar. Battery. Energy of a battery. Effects of the electric discharge.

Dynamic Electricity.—Principle of Volta. Laws of successive contacts. Various cells. Electric current. Properties of the electric current. Intensity of a current. Electric resistance. Ohm's law. Total electromotive force of a cell. Practical units of intensity, resistance and electromotive force. Power of a cell. Practical unit of work. Practical unit of force. Thermal effects of electric current. Chemical effects of electric current. Voltmeter. Measure of the intensity of a current. Various electrolyses. Various applications. Various accumulators. Oersted's experiment. Galvanometers. Solenoids. Similarity between magnets and solenoids. Magnetisation by currents. Electro-magnets. Telegraphs.

Electric induction. Induction by variation of intensity of an electric current; Ruhmkorff coil. Telephones. Induction by magnets. Law of Lenz. Gramme's machines with continuous and alternating currents. Energy of an electric machine, its reversibility. Transport of energy to distance. Electric lighting.

Acoustics.—Production and propagation of sound. Velocity. Intensity, pitch, timbre.

Optics.—Propagation of light. Umbra and penumbra. Law of reflection. Spherical concave and convex mirrors. Refraction. Prisms. Lenses. Magnifying-glass. Compound microscope. Astronomical telescope. Terrestrial telescope. Galileo's telescope. Newton's telescope.

Dispersion of light. Solar spectrum. Colour of bodies. Contrast of colours. Spectrum of different luminous sources. Non-luminous spectra. Photography.

Radiant heat. Thermal conductivity of bodies.

15. *Geography.*—*Economic Geography* occupies a preponderating part in the examination. The preparatory studies are expected to cover the following ground, viz.:—

I. Object and utility of geography. How it is applied to the study of economic questions. Utility of mural charts and summary sketches.

II. *France.*—Study of physical geography. Its intimate connection with economic geography.

Composition of the soils of France. Various kinds of earths: Mineral and arable soil.

Relief. Study of mountain groups and chains, plateaux, plains, and valleys. How the relief obstructs or facilitates communication. Saddles and natural passes.

Climates. Principal divisions and contrasts, oceanic, Mediterranean, and continental climate. Winds and rains. Influences of various climates on forests, cultures, prairies, coastal navigation.

Streams and rivers. Physical description: The utility of running waters to agriculture by irrigation, to industry by motive force, to commerce by navigation.

Coasts. Form, nature, facility or difficulty of access, tides, fishing.

Agriculture. General condition of French agriculture. Principal productions and progress realised (cereals, vines, forests), etc. Importance of cattle-breeding, etc., and products so obtained.

Industry. General condition of French industry. Insufficiency of coal and raw materials. Productions and great centres of their metallurgic, alimentary, and textile industries.

Ways of communication. Net-work of navigable ways; their direction by reason of the relief; importance and nature of the transports in the various districts. Net-work of railways; the great companies; physical and economic study of the principal lines. How they are connected with our great ports and the great foreign routes. The great marine navigation companies.

Commerce. Its value: Nature and production of the principal merchandise imported into France; nature and destination of merchandise exported to foreign countries. Foreign competition.

Ideas concerning population, race, emigration, the political and administrative régime.

III. *The French colonial dominions.*—Physical and economic study of the French colonies.

In Africa: Algeria, Tunis, Western and Central Africa, Congo, Obock, Madagascar, the Reunion.

In Asia: French India and Indo-China.

In Oceania: New Caledonia, Oceania.

In America: Guiana, the French Antilles, Saint-Pierre, and Miquelon.

Study of the climates, the mineral and agricultural resources, the populations, commercial relations between France and foreign nations.

IV. *Europe.*—Physical and economical study of the various States and their colonies, Great Britain, Russian Empire, German Empire, Holland, Belgium, Spain, Portugal, Italy, Switzerland, Austria-Hungary, The Balkan Peninsula, Sweden and Norway, Denmark. The principal natural wealth of the various countries and the causes which have contributed to the development of their industrial and commercial activity.

Population and density. Emigration and colonisation. Great international ways. Commercial relations with France.

V. *Asia.*—Turkish Empire, Chinese Empire, Japan. The extent, population, the great ports entered by the European navies, and the great Asiatic railways.

VI. *Africa.*—Summary study of physical geography. The temperate and the tropical climates. The rôle of Africa among the nations of Europe.

Summary study of physical and economic geography: Morocco, Egypt, and the Suez Canal. Abyssinia. Oriental Soudan. The Congo State. Central Africa, German and English. English South Africa.

Independent States: Orange Free State and the Transvaal.

Oceania and Australia.—The Sunda and Philippine Archipelagos.

America.—Canada. United States. Mexico. Central America. Antilles. Brazil. Paraguay. Uruguay. Argentine Republic. Chili. Peru. Bolivia. Colombia, etc.

Summary study of natural resources. The progress and power of the United States, the rôle of European emigration, the question of isthmuses, the relations to France and Europe.

16.

16. *History.*—The subject of History does not go beyond modern period. It is expected to cover the following ground, viz. :—

The modern world.—Establishment of French unity and absolute monarchy with Louis XI and Francis I. Rivalry between Francis I and Charles-Quint: The principle of European balance of power. Results of the great inventions and marine discoveries of the fifteenth and sixteenth centuries. Influence of the Renaissance and Reformation. Succinct statement of the religious wars in France.

Henry IV.—Edict of Nantes. Sully, O. de Serres, Champlain. State of Europe in 1610.

Louis XIII.—Etats généraux in 1614. Richelieu : struggles against protestants and the nobility. The Thirty Years' War, particularly the French period, treaties of Westphalia.

Minority of Louis XIV.—Mazarin and La Fronde. English Revolution of 1648. Cromwell. The Pyrenees Treaty. Condition of Europe in 1660. Personal government of Louis XIV: Mechanism of absolute monarchy. Reforms and work of Colbert and Louvois. Vauban. The wars of Louis XIV and the great treaties of his reign : Breda, Aix-la-Chapelle, Nimègue, Ryswyck, Utrecht, and Rastadt. Revocation of the Edict of Nantes : its political and industrial consequences. English revolution of 1688 : Parliamentary monarchy. Literature, science, and arts in the 17th century. Europe about 1715.

Reign of Louis XV.—The Regency and Laws' system. Treaties of Madrid, Vienna, Aix-la-Chappelle, Paris, and Hubertsbourg. Rivalry of France and England in the Indies and in Canada: Dupleix, La Bourdonnais, Montcalm. Ministry of Choiseul. The first division of Poland. Reformation of justice by Maupeou and the struggle of Parliaments against the Royal power. Writers, scholars, philosophers, French economists of the 18th century.

Reign of Louis XVI.—Turgot. Necker. Attempts at reform in France and Europe. The American War of Independence and the Treaty of Versailles. Constitution of the United States Republic in 1787. General view of Europe in 1789.

The old régime and the Revolution. Etats généraux of 1789 and constituent Assembly. The declaration of the rights of man and the Constitution of 1791. The Legislative Assembly. The National Convention : Girondins and Montagnards. Robespierre and the 9th Thermidor. Wars of Vendée. The wars of the Revolution. Valmy, Jemmapes, Fleurus ; the treaties of Bâle. The two last divisions of Poland and the Eastern question. The "Directoire." Bonaparte in Italy. Treaty of Campo-Formio. The Egyptian and Syrian Expeditions. Zurich and Bergen. The 18 brumaire. The Consulate. Institutions of the Consulate : Civil Code, Concordat, Bank of France, Legion of Honour. Marengo and Hohenlinden. Treaties of Luneville and Amiens.

The Empire. Ulm, Trafalgar, Austerlitz ; Treaty of Presbourg. Jena and Auerstadt; Eylau and Friedland. Peace of Tilsitt. Wars of Spain and Portugal: the Continental blockade. Essling, Wagram : treaty of Vienna. The Empire of Napoleon I about 1810. The Russian Expedition. The Saxony campaign, and invasion of France in 1814. The first restoration : Louis XVIII and the Charter. The hundred days. Waterloo. The treaties of Paris, the congress of Vienna and the Holy Alliance. State of Europe in 1815.

The second restoration : the two ministries of the Duc de Richelieu. Reign of Charles X : Battle of Navarin and the taking of Algiers. The ordinances and the days of July, 1830. Reaction of the Revolution of 1830 in Belgium, Poland and Spain. The emancipation of the Spanish colonies of America. Reign of Louis Phillippe I. The Eastern questions, Turkey and Egypt, India, Turkestan, China. Conquest of Algeria. The Revolution of February, 1848, and its reaction in Italy, Germany, and Hungary. The Second Republic and the *coup d'état* of the 2nd December, 1851. The Second Empire. The Eastern Question. The Crimean War and the Treaty of Paris. Formation of Italian Unity : War of Italy and Peace of Zurich. The Syrian and Mexican Expeditions. Development of the United States of North America and War of Secession. Formation of the German unity: War of France and Prussia; treaty of Frankfort-on-the-Main. The Third Republic. The Commune. Presidencies of Thiers and MacMahon: the Constitution of 1875. Literature, arts, sciences in the 19th century. Principal geographical discoveries and formation of the French Colonial Empire. Progress of industry and commerce: steam and electricity; commercial treaties and universal exhibitions.

Most importance is attached to contemporary history, that is since 1789, and to the facts of constitutional and social hsitory. Military history need not be learnt in detail; it is sufficient to know its principal features.

17. *General Remarks on Preparation.*—The preceding courses, if taken normally, do not present great difficulty. The clear specification of the range, and the fact that no weight is attached to questions that exhibit the ingenuity of the examiner rather than test in a reasonable way the knowledge of the pupil, makes it satisfactory. It cannot be regarded as other than a reasonable preparation for such a course as the Higher Course in Commerce.

18. *General Programme of the Course.*—The course itself, two years in length, can be grasped in a general way by reference to the following time and examination table.

Programme and Examination Table, "Ecole supérieure du Commerce," Lille.

Subjects.	Hours per Week and Years.		Examinations.					
			First Year.			Second Year.		
			Special Examinations.		Final Examinations of Year—Co-efficients.	Special Examinations.		Leaving Examinations—Co-efficients.
	I.	II.	Written.	Oral.		Written.	Oral.	
Commerce, Accountancy	7	6	4	3	3	5	3	11
English (Obligatory)	4	4	3	2	3	3	2	11
German or Spanish	4	3	2	2	2	2	2	10
Mathematics	1	2	3	...	2	3	...	10
Merchandise and Essays	2	1	3	..	2	2	...	8
Economic Geography	2	2	4	...	2	3	...	9
History of Commerce	...	1	...	...	...	2	...	3
Elements of Public and Civil Law	2	...	...	3	2	...	...	5
Commercial and Marine Law	...	2	...	...	...	...	3	5
Industrial and Workmen's Legislation	...	1	...	...	...	...	2	4
Fiscal and Customs Legislation, Political Economy	...	2	...	...	...	...	3	6
Transport and Plant	1	...	2	...	2	...	...	6
Organic Chemistry	1	...	2	...	2	...	...	4
Trade in Textiles, Thread, and Fabrics	...	2	...	...	...	2	2	8
Caligraphy	1	...	2	...	...	...	...	...
French, Commercial Correspondence	2	1	3	...	...	3	...	...
Totals	27	27	28	10	20	25	17	100

The

The details of the various courses are given hereunder, in order to exhibit the real significance of the courses.

19. *Commerce and Accountancy* (2 years).—Instruction in the general notions of commerce, and in arithmetic as applied to commerce and accountancy, are given simultaneously. The instruction is both theoretical and practical, and the instructor has recourse to numerons examples revealing the application of the theoretical teaching.

During the lessons typical examples of various commercial documents are placed before the pupils for them to study.

In the lessons on the application of arithmetic to commerce, a portion of the time is specially devoted to practical exercises in rapid mental and in written calculation.

During the first year, the theoretical exposition of accountancy is accompanied by a practical and complete scheme of book-keeping, and, in the second year, developed by monographs on the subject in question.

The general development of the course is as follows:—

(I.) *General ideas concerning Commerce and study of Commercial Documents.*

Commerce.—Commerce in general. Wholesale and semi-wholesale trade. Retail trade. Internal trade. External trade. Importation. Exportation.

Merchants.—Manufacturers. Merchants. Bankers. Exchange-brokers. Stock-jobbers (*coulissiers*). Merchandise brokers. Maritime brokers. Commissioners. Representatives. Warehouse clerks. Commercial travellers, etc.

Exchange.—Exchanges in kind. Commercial Exchange: buying and selling for cash, with or without discount. Buying and selling on terms or on account, with or without interest. The art of buying and selling: general principles. Knowledge of merchandise. Knowledge of requirements. Knowledge of markets and sources of supply. Computation of presumed profits.

Documents relating to Exchanges.—Buying order. Selling order. Invoice. Note. Receipt. Memorandum. Commission. Delivery. Receipt. Card of samples, etc.

Exchange regulations.—Concerning money. Bank-note. Paper-money. Ordinary cheque; crossed cheque. Money order. Bill of exchange. Mandat. Delegation. Letter of credit. Transfer.

Regulations as to payment. In specie, in bank-notes, in paper-money, by cheque, by transfer of account. Regulations with regard to transactions on terms: bills, etc.

Transport.—Transport by carriage; by railway; by canals and rivers; by sea. Packages of merchandise for despatch. Formalities of expedition. Insurance.

Invoice.—Note or memorandum of despatch. Bill of lading. Conditions: Cost, freight, and insurances. Various tariffs of dispatch. Insurance tariffs.

Custom-duties and excise. Mode of acquittal of Custom-duties and excise. Régime of spirituous liquors. Permit. Various documents.

Bonded Warehouses.—Bonds. General warehouses. Their activities. Warrants and receipts. Warehouse sales. Public sales.

Bankers.—Utility of bankers and of bank-credits. Usual banking operations: discount and operations with commercial bills, invoices, receipts, etc. Deposits of money, title-deeds, of valuables. Advances on deeds, merchandise, various securities. Payment of dividends. Overtures of credit. Delivery of cheques, of mandats, of letters of credit, etc.

Chambers of Compensation and "*Caisse de liquidation.*" Practical function. Clearing-house of London.

Bourses.—Their function.

Merchandise Exchange.—Businesses which involve them. Cash operations. Term operations. Speculation bargain. "*Mercuriales.*" Premiums for raising, premiums for delivering; double premium or option; merchandise quotations.

Merchandise Brokers.—Bank of liquidation. Its function.

Exchange Values.—Examination of the rate. Public funds. Capital shares. Bonus shares (*actions de jouissance*). Obligations. Shares. Bearers of share certificates. Nominative share certificates. Lost share certificates. Opposition. Transfer. Conversion.

Various investments. Investments at fixed interest. French annuity. Foreign public funds. French and foreign obligations. Preferential shares (*actions privilégiées*). Investments at variable interest. Shares of Societies of Credit, or railways, of industrial enterprises. Investments at fixed interest with profit-sharing. Obligations of the Credit Foncier of France, of the City of Paris, etc. Temporary investments. Continuations. Treasury-bills. Savings Bank. Accounts-current in banks.

Cash operations.—Operations on terms. Cash and term operations combined. Firm markets, markets at a premium; scale of premiums; response of premiums; liquidations; prolongation; delay; discount; course of compensation.

Insurances.—Practical examination of the various modes of insurance; life, fire, and accident insurance. Merchandise insurance; marine insurance.

Business Syndicates.—Combining of capital in view of commercial, financial, industrial, or agricultural operations.

Ideas concerning commercial and industrial management. Organisation of a mercantile establishment; order; economy. The capital necessary for enterprises. Necessity of properly determining it. Fixed capital. Circulating capital. Raw material. Merchandise, productions. Markets. Workmanship. General expenses; fixed and variable general expenses. Importance of the exact estimation of these expenses. Their influence on the net cost according to the total amount of business of the merchant or manufacturer. The rôle of accountancy. Registers and statistics within its sphere. Exact determination of net costs. Permanency of inventory by the profits. Management of businesses. Moral and material conditions of their success. Credit and its means of operation. Publicity; utility; various modes, their advantages and inconveniences. The rôle of intermediate agents.

The duties of an employé, the merchant, the manufacturer, the administrator, the sleeping partner, the secretary, the shareholder.

20. *Applied Arithmetic.*—Commercial Arithmetic is treated as follows:—

(II.) *Arithmetic applied to Commerce.*

Mental and rapid calculation.—Daily exercises. Study of abridged methods of arithmetical operations.

Interest, Discount, Commission.—Definitions of interest. Exercises by the method of numbers and divisors. Exercises in aliquot parts. Definition of discount. Discount on foreign and inland bills. Mean maturity. Average maturity. The making of discounted bills calculated at various rates. Commissions. Manner of calculating them and applying them to discounted bills and cash accounts, by means of bank tariffs. Relation of commission and interest: tables of comparison to be established.

Accounts-current and Interest.—Definition of accounts-current and interest; calculation by numbers and aliquot parts; Hamburg method; example thereof; its advantages. Direct method; example; with and without interest, etc. Advantages. Indirect or retrograde method; example and advantages thereof. Practical exercises concerning the three methods. Various kinds of accounts-current: (1) Accounts-current reckoned and fixed at each variation of rates of interest; (2) Accounts-current calculated for fixed terms and at uniform rates of interest, debit and credit; (3) Accounts-current calculated and fixed at definite periods and at differential rates of interest between the debtor and creditor; (4) Accounts-current calculated and settled at each fluctuation of debit or credit. Practical exercises with application of various commissions, etc.

Various

Various Systems of Weights, Measures, and Coins.—Statement of the principal systems. Comparison with the meteric system. Reduction of foreign money to francs, and *vice versa.* Equal intrinsic value, tariff value, and commercial value of money. Employment of the conjoint rule.
Net Costs and parities in Merchandise.—Buying, accounts and account sales. Factors of net cost from estimate. Calculation of costs. Method of forming them. Constructions of net scales and manner of employing them. Gross parities; net parities of weight; of price; tables thereof. Utility of these for ascertaining the condition of the foreign market. Application to various mercantile transactions.
Arithmetic.—Applications to the solution of problems of interest, discount, mixture, division, reduction of moneys.
Exchange Operations.—Calculation concerning exchange operations: purchases, sales, arbitrations of values, calculation of these operations. Expenses of which it is necessary to keep account. Calculations concerning term operations: purchases, sales, steady markets, markets at a premium, combined markets, scale of premiums.
Calculations concerning mercantile operations. Cash transactions, purchase and sale. Expenses. Term operations: purchases and sales.
Banking Operations.—Precious metals. Calculations of alligations. Gold and silver quotations at Paris, London, and New York. Calculation of the value of an ingot at the various places.
Gold Points.—Parities of gold. Parities of the pound sterling, etc.
Exchanges.—Definition of exchange. Reading of the rate of exchange of Paris and foreign countries. Long and short bills. Values negotiable within three months. Values negotiable at sight. Countries introducing uncertain and those giving certain values.
Exercises in exchange calculations. Theoretical and practical means. Use of the conjoined rule. Levelling of the course of exchange.
Arbitrages.—Definition. Position of debtor: means of discharging his debt. Position of creditor; ways of recovering debt. Speculators or arbitrators. Arbitration calculations with State funds and other exchange values.
Cyphered quotations.—Definition, utility; quotations at various places cyphered at Paris. Problems and operations concerning these. Quotations cyphered for foreign places. Conjoints and parities. Calculations.
Bank-orders.—Division of bank orders into two kinds: (1) Foreign orders transferred to Paris; (2) Paris orders transferred to foreign country. Elements of which the bank-orders consist: (i) limit; (ii) purchasing price for values demanded; (iii) selling. *Arbitrages* and parities of these three. Determination of the profits or loss on such transactions. Expenses of which it is necessary to keep account in the *arbitrages*: Stamp, brokerage, transport, insurance. Detailed indication of these various expenses for the financiers of the principal countries and expenses which are added to the purchasing-price or deducted from the selling-price. India Council.

21. *Book-keeping and Accountancy.*—The subject is developed as follows:—

(III.) *Accountancy.*

Elements and General Theory of Accountancy.

Principal expressions of Accountancy.—Debtor, creditor. Debit. Credit. "Entree," "Sortie." Accountancy. Book keeping. Definition. Various kind of accountants.
Account.—Definition of account. Manner of drawing an account. Receipted and accepted accounts. The day or cash book taken as an example. Practical exercises.
Certified documents of the flux of receipts and expenditures. Closing and re-opening of cash accounts. Balances, etc.
Impersonal accounts, representing the values of the inventory of an enterprise. Personal accounts, representing the debtors or creditors of an enterprise.
The Day-book.—Definition. Arrangement of the day-book. Formulæ of entries in the day-book. Single day-book. Various modes of division of a day-book. Auxiliary, or analytical day-book, recording entries and outgoings, of warehouse, workshop, etc., and transactions by entries. General or synthetic day-book. Models. Formulæ of articles recapitulating the relations of auxiliary day-books, with regard to the general day-book. Practical exercises with documents. Importance of casting-up the auxiliary day-books and the general day-book.
Ledger.—Definition. Arrangement of the ledger. Single ledger. Divided ledger. General or synthetic ledger auxiliary, or analytical ledger. Models.
Relation of the day-book to the ledger. Practical exercises in the opening of accounts and their transference from the day-book to the ledgers. Precautions to be taken for the avoidance of error. Agreement of the general day-book and the general ledger. Agreement of the general ledger and the auxiliary ledgers.
Collective accounts.—Definition. Utility of collective accounts for controlling the collection of accounts opened in the auxiliary ledgers, and for the simplification of the balance of accounts.
Balance of accounts.—Definition. Agreement of the entries in the day-books and accounts in the ledgers, obtained by the balance of accounts. Periodic balances. Daily balances. Utility of the frequency of balances. Models of balance of the general ledger, with or without collective accounts. Models of auxiliary ledgers. Model of balance of general ledger, with methodical classification of accounts.
The Cypher-balance.—Definition. Its functions, its utility. Daily balances obtained by means of the cypher-balance.
Division and classification of accounts.—Various kinds of accounts. Necessity for a classification. Mathematical expression of commercial operations. The rational classification which results; accounts of nominal capital. Accounts of values or means of carrying on of enterprises. Accounts of debtors and creditors. Accounts of the results of exploitation. Permanency of the inventory.
Analysis of the various series of accounts.—Nominal capital of enterprises: capital shares. Capital obligations. Reserves. Various amortisations. Accounts of values of stock-in-trade, etc.: net cost.
(a) *Fixed values.* Stock-in-trade. Shares. Expense of establishment. Real and personal property. Working capital.
(b) *Disposable values.*—Money, dues, deeds, raw material, warehouses.
(c) *Involved values.*—Manufactures, constructions, speculations, participation, limited joint-stock companies. Agencies, cultures, etc. Debtors and creditors accounts, sale or purchase price. Results, debits and credits on the differences between net cost and return or sale price. Account sales. Incidental profit and loss. Results of various operations. General expenses. General costs.
Inventory.—Balance-sheet.—Balance of inventory, with classification of accounts. Inventory of order. Balance-sheet. Book of balances. Book of inventories (stock-book).

Applications.

Organisation of Books and Accounts.—General principles of organisation of books and accounts of capitalists, merchants, manufacturers and agriculturists.
Opening of the books of the various companies. Companies in a collective name; joint-stock companies, co-operative societies, or companies with variable capital; *sociétés civiles,* mutual help (friendly) societies; participations. Operation of the various series of accounts. Utility of various accounts in each series.
Private Accountancy.—Inventory of entry giving the composition of the capital at the beginning of the enterprise. Opening of accounts in conformity with this inventory, and in the order of a rational classification. Operation of a period, including: expenses, receipts, purchase, and sale, management of an estate, sleeping partner in an enterprise, etc. Inventory of accounts, determining the situation of the capital at the end of a period. Balance-sheet.
Commercial Accountancy.—Inventory of entry giving the composition of the capital at the beginning of the enterprise, and opening of accounts (as before). Series of commercial operations, including purchases, sales, returns, various cash, term, on account settlements; consignments; joint business; account-current with the banker, etc. Purchase accounts, stock accounts, and accounts-sales. General expenses. Abstract of the statistics of expenses, either in the auxiliary ledger or by means of a synoptic table. Distribution of the general expenses in the purchase-accounts. Annual amortisation of realised values. Inventory of accounts determining the position of capital at the end of the enterprise. Balance sheet. Book of inventories.

[*Industrial*

Industrial Accountancy.—Inventory of entry, etc. (as before). Organisation of books and entries taking account of the division of industrial work and in view of methodically ascertaining the net cost of manufactured articles.

Purchase of raw materials in France, or in foreign countries : Purchase and stock-accounts of raw materials, debited at the average net cost of the purchases. Manufacture or successive conversions of raw materials : manufacture accounts (a manufacture account for each stage of conversion of material). Periodic division of raw material, of workmanship, and general expenses in the manufacture accounts. Determination of the coefficient of division of general expenses.

Manufactured Articles.—Warehouse accounts of manufactured articles receiving these articles of manufacture accounts at final net cost.

Sales.—Account-sale, debited at net cost, credited at selling-price. Other accounts of results. Incidental profits and losses, results of various operations, commissions, etc. *Closing of accounts.* Inventory of goods on hand, of furniture, immovables, cash, raw materials, materials for manufacture and manufactured materials, etc. Various amortisations : Inventory of accounts. Arrangement. Determination of the final result and of the final state of capital. Balance-sheet. Book of inventories (stock-book, etc.) Accountancy of joint businesses. Book-keeping of factors. Book-keeping of the shipowner. Accountancy of a bank with accounts relative to buying and selling, bullion, of exchange, and arbitrage, financial participations, etc. The accountancy of a Railway Company, of Insurance Companies, of a Savings Bank. Agricultural accountancy.

Study of the various systems of Accountancy.—" *Logismographie.*"—Private accountancy, etc.

Diagrams of Accountancy.—Preparation by the pupils of synoptic tables recapitulating the classification and function of various systems of accounts. Comparative study of these diagrams and balance-sheets.

Commercial Correspondence.—Necessity of negotiating business by correspondence, so as always to be able to trace every operation.

Style of commercial correspondence. Exercises. Registering and classification of the despatches. Copy of letters and despatch-book, etc.

22. *Foreign Languages.*—These last two years, and include the English language, which is obligatory ; German or Spanish ; and the study of commercial documents and commercial correspondence in the foreign languages.

In the second year, the courses are studied exclusively in the foreign languages taken. Details are unnecessary.

23. *Applied Mathematics* (2 years).—The course in applied mathematics is developed as hereunder :—

Generalities.—Divisions into proportional parts, shares, etc.

Simple Interest.—General formula. Method of numbers and devisors ; aliquot parts of the rate ; aliquot parts of the time and of the principal.

Discount.—Various kinds of discount. Solution and discussion of the various problems concerning discount. Thoyer's method ; improvements introduced by Cauchy.

Accounts-current and interest.—Mathematical study of the three methods : (1) direct ; (2) indirect or retrograde ; (3) Hamburg method, or to scale.

The Precious Metals and the Monetary system.—Alligations ; problems relative thereto. Money, manufacture or to scale ; deduction ; monetary system of France ; Latin union ; monetary system of countries which are not members of the Union. Relation of the values of gold and silver : (1) legal relation ; (2) commercial relation.

Definition of arbitrages. Direct and indirect arbitrages.

Construction of tables of parity.

Numerous exercises with regard to arbitrages between Paris, London, Amsterdam, etc.

Arbitrages, principally between London and Paris, as to metals, etc.

Arbitrages with regard to public funds. "*Reports.*"

Theory of Financial Operations at a Long Term.

Compound Interest.—Definition and fundamental formula. Study and discussion of two schemes according to which the value of an investment at compound interest can be estimated, when the duration is expressed by a fractional number. Generalisation of the theory of exponents. Ideas with regard to the equivalent rates. Exponential formula applicable to every case. Formulæ of instantaneous rate and of continuous interest applied by French and English actuaries.

General solutions of problems of compound interest. Practical calculations. Use of the logarithmic and numerical tables of Violeine, Peréire, and the Annuaire of the *Bureau des longitudes.* Calculation rules.

Examination of the time necessary for doubling, trebling, etc., a principal invested at compound interest. Present value of a principal payable at term. Discount. Various modes of discount. Comparison and discussion. Mean maturity of several principals payable at different dates in taking account of compound interest.

"*Rentes.*"—*Annuities.—Periodic Payments.*—Definitions and examples. Distinction of limited or interminable annuities, immediate or deferred annuities. Value at a fixed period and according to a rate of interest determined by any series whatsoever of periodic payments. Constitution of a definitive capital by annuities. General formulæ of annuities. Calculations of various elements. Special study of the difficulties the examination of the rate in the problems of annuities presents. Algebraical solutions and approximate practical solutions. Formulæ of F. Bailly, of Makeham, etc.

Annuities or incomes at variable terms. Studies of the principal cases. " Rentes " varying according to the law of arithmetical progression or of a geometrical progression.

Amortisation of loans by annuities.—General relations between the principal, annuity, the rate of interest and the time.

Relations between the rate of interest and the rate of amortisation. Formulæ and tables.

Public loans contracted by the issue of obligations. Constructions of tables of amortisation.

Study of the different complications which may be met with in the practice of amortisation.

Numerous examples derived from public loans contracted either in France, or in foreign countries.

Selection of problem with regard to financial operations at a long date.

Probability.—Chances and Risks.—Elementary ideas concerning the calculation of chance. Public lotteries. Actual value of a sum the payment of which is eventual. Compound probability. Repetition of tests. Law of large numbers. J. Bernouilli's theorem.

Applications of the ideas of the calculation of probabilities to the study of the laws of human mortality.

Table of mortality. Duration of probable life. Probability of survival. Duration of average life.

Study of the risks of properties and merchandise.

Application of the Mathematical Theory of Financial Operations.

French and Foreign State Funds.—Government annuities. Issue. Negotiation. Accurate calculations relative to the various types of annuities. Interminable income and income subject to amortisation. Calculations of parities (equivalents of various kinds).

Study of public funds in foreign countries, England, Germany, America, etc.

Industrial Values.—Railway companies. Financial relations between the State and the great Railway companies. Conventions of 1859 to 1868 and ulterior modifications. Reserved net proceeds. Mechanism of the *déversoir.* Guarantee of interest and subsidies granted by the State. Conventions of 1883. Matters to be considered in the estimation of the anticipated costs of obligations and railway shares. Capital shares and bonded shares (*actions en jouissance*). Study of the various questions relative to the dissolution of an industrial company.

Loan

Loan lotteries. Special study of the loans of the city of Paris.

Applications of the principles of the calculation of probabilities to the estimation of the chances of lottery, of the chances or risks of reimbursement.

Analysis of the various systems of loan-lotteries practised both in France and in foreign countries.

Financial Operations at Long Term of great Credit Establishments.—Crédit foncier societies. Statutes and operations of the Crédit foncier of France. Conditions of the loans on mortgage and the loans accorded to the communes and the departments.

Foncière and communal obligations. Foreign mortgage banks.

Crédit foncier and agricultural credit of Algeria. Colonial Crédit foncier. Study of the operations of crédit foncier societies in other countries.

Principal banking operations relative to Public Issues.—Issue of obligations in representation of the loans accorded by the great credit establishments. Conversion of a fixed loan into another loan for which the conditions of interest and amortisation are different. Distinction between the nominal and actual capital, the nominal and actual rate. Net cost of the obligations and profits of the contracting banker. Average cost, according to a fixed rate, of the titles of a definite loan, for any period whatsoever, while taking account of all the conditions relative to the payment of the dividends of interest, costs, and premiums of reimbursement.

Assurance.

Generalities.—Elementary ideas of the calculation of probabilities. Law of large numbers. Discrepancies.

Actual value of an eventual transaction.

Insurances, various branches thereof. *Insurances of persons.* Tables of mortality. Principle of their construction. Adjustment. Principal tables in use. Curves and equations of mortality. Probable life and average life.

Principal categories of life insurances. Principal and annuities in cases of life or death, on one or several lives. Unique and purely annual premiums. Tables of commutation. Tontines. Property without the usufruct of it, and usufructs. Reserves of life-insurance.

Tables of disease, of disablement, and of mortality.

Calculation of simple insurance premiums against disease and disablement. Reserves of these insurances. Insurances against accidents. Coefficients of risk.

Insurance of goods. Summary ideas concerning the technical function of insurances against fire, material accidents, risks in transport, etc.

Operations of Insurance Companies.—Commercial tariffs. Costs. Freights. Inventories. Reserves *de prévoyance.* Re-insurances, etc.

Participation of the insured persons in profits. Cancelling and modification of policies.

Workmen's Insurance.—State banks. Old-age pension fund.

Mutual Help Societies. Their aim. Technical rules to be adhered to in their organisation and management. Errors to be avoided. National provident institutions.

Numerical Calculations.

Abbreviated methods Tables of compound interest and annuities. Tables giving the value of obligations, that of life operations, etc.

Mechanical processes for the rapid execution of numerical calculations. Calculation rules. Calculating machines. Summary enumeration of the principal works published in France and in foreign countries concerning the technique of financial operations.

The above course will commend itself to actuaries and professional accountants for its practicality and thoroughness.

24. *Study of Merchandise.*—In placing before the pupils the greater part of the merchandise referred to in the programme, the professor describes the different commercial species, their origin, composition, extraction and manufacture, the mode of despatching them, their use, the adulterations and falsifications to which they are liable, and the means used for recognising these. He indicates the most important of the various products, the commercial and statistical usages which relate to them. He then proceeds to demonstrate the most simple commercial experiments, viz., those which require neither professional chemical knowledge nor the resources of an analytical laboratory.

First Year.

Substances of Mineral Origin.

Water.—Potable water; qualitative experiments, hydrotimetrics. Mineral waters, establishments and depôts; regulation. Artificial and ærated waters; natural ice, Norwegian and artificial ice.

Sulphur.—Natural state. Mineral sulphurs. Sulphurous acid. Sulphuric acid. Carbon disulphide. Sulpho-carbonates

Phosphorus.—Ordinary, amorphous: Phosphorus paste. Natural phosphates, nodules, sands, calcareous phosphate strata. Superphosphates.

Arsenious acids and arsenic acid. Realgar, orpiment.

Chlorine.—Decolorant chlorides.

Hydrochloric acid, hydrofluoric acid. Fluor-spar, cryolite.

Iodine. Bromine. Iodides, bromides.

Ammonia.—Ammonium. Hydrochloride, sulphate, carbonate, nitrate.

Nitric acid.—Protoxide of nitrogen.

Carbon.—Diamond, graphite. Jet.

Coal, classification. Anthracite, lignite, turf.

Metallurgic coke; conglomerates.

Coal basin of the North of France, ramifications. Principal concessions. Foreign coals. Commercial customs, statistics.

Natural carbides of hydrogen: petroleums, naphthas, schist oils. Rectification, purification, products and by-products. Commercial experiments. Police regulations.

Coal gas. Photometric standard. Tar, ammonical waters, coke. Distillation of tar.

Thermal and photometric value of the principal combustibles: solid, liquid, and gaseous.

Potashes and sodas.—Commercial species and denominations. Purchases on analysis. Alkalimetry.

Caustic potashes and sodas.

Chloride of potassium, Stassfurt strata.

Saltpetre, chlorate, cream of tartar. Rock salt. Bicarbonate of soda. Sodium sulphate.

Nitrate of soda of Chili. Importance as manure.

Statistics and commercial documents.

Limes and limestones.—Limestones, their classifications and denominations. Mortars, cements, plasters.

Chalk, marl, building-stones, marbles.

Siliceous minerals.—Sandstone and siliceous sands, millstones, granite, porphyry, basalt. Slates, pumice-stone, porcelain clay, argil, felspar, tripoli.

Ceramics.—Terra-cotta lumber, bricks, etc.

Glasses and Crystals.—Window-glass, bottles, tumblers, wine-glasses, etc. Crystal. Plate-glass.

Aluminium.—Metal, bronze. Emery. Sulphate of aluminium, alums. Artificial ultra-marine.

Magnesium.—Metal, lighting. Magnesia, sulphate of magnesia. Dolomite, basic revêtement, talc, amianthus, and asbestos. Manganese. Dioxide. Ferromanganese (spiegel): Permanganate. Iron. Minerals, principal strata. First-fusion castings.

Refining, dephosphoration. Iron, steel. Steels compounded with tungsten, chromium, nickel, silicon. Scoriæ of dephosphoration, slag-wool.

Colcothar, English red, sulphate of iron, prussiates, Prussian blue.

Nickel.

Nickel.—Ores, metal. Nickel-plating.
Chromium.—Chrome iron. Alkaline chromates.
Zinc.—Ores, metal. Galvanising. White zinc.
Tin.—Ores, metal. Stream or solid tin, tin salt (stannous chloride). Tin-plate.
Antimony.—Pure metal, type metal.
Copper.—Ores, metal. Bronzes. Brass, German silver. Siliceous bronze.
Sulphate of copper, greens with a copper base. Malachite.
Lead.—Ores, metal. Massicot, litharge, red lead, white lead. Chromates of lead.
Mercury.—Ores, metal. Amalgamation. Dichloride, reglementation. Cinnabar, vermillion.
Silver.—Ores, metal, alloys, standards.
Gold.—Extraction, alloys, standard, experiments with touchstone.
Platinum.—Platino-iridium.

Second Year.

Products of Vegetable Origin.

Fruits.—Fresh fruits and vegetables. Oranges, apples, etc. Preserves, conserves.
Dried fruits. Raisins, prunes, figs, dates, etc.
Oleaginous fruits. Olives, earth-nuts, cocoa-nuts, etc.
Alimentary farinas.—Cereals : Grain, wheat, barley, rye, oats, maize, rice. Buckwheat. Statistics.
Legumes. Kidney-beans, peas, broad beans, lentils, etc.
Potatoes. Alimentary and industrial varieties.
Starch, fecula, gluten. Alimentary pastes, tapioca, etc.
Dextrine, glucose, maltose.
Milling flour, bran, pollard, etc. Commercial denominations and statistics.
Panification and various products.
Oleaginous seeds.—Native seeds : field-poppy, linseed and field-cabbage ; foreign : poppies, linseeds, colzas, sesame, *illipé*, etc.
Various products. Tobaccos : indigenous, exotic ; classification. Cinchonas, sulphate of quinine. Coffee, tea, cocoa, pepper, cinnamon bark, etc.
Wood.—Indigenous, exotic. Timber for constructions, for carpentry, for cabinet-work, and firewood ; mine props, railway sleepers ; injection of wood.
Exploitation of forests, wood coal, cork.
Practical formulæ of cubature (estimating volumes of).
Fatty substances.—Olive oil, colza oil, linseed oil, field-poppy oil, nut oil, etc. ; earth-nut, sesame, palm, etc. Industrial oils.
Tanning and astringent substances.—The bark of the oak-tree, gall-nuts, wood of the chestnut-tree, sumac-tree, cachou, etc. ; extracts, tannins.
Tinctorial substances.—Cardamoms, curcuma, annotto, archil, etc. Madder, natural alizarine, synthetic alizarine, campeachy wood, quercitron, bog-wood, etc. Indigo, sulphate, carmine ; extracts, lakes.
Inspissated juices and extracts.—Gums, caoutchouc, gutta-percha ; resins ; turpentine, colophony, and oil of turpentine, benzoin, balsams, etc. ; gum lac, copal, etc. ; asafœtida, dragons' blood, etc. ; camphor, opium. Alkaloids.
Paper.—Raw materials : rag, straw, alfa, wood pulps. Various kinds, pasteboard. Commercial forms. Parchment paper. Stained-paper.
Sugar.—Raw materials : sugar canes, beetroots. Moist sugars : white, brown sugar. Commercial analysis, excise analysis, determination of the composition.
Molasses, pulps, beet-root salts.
Refined sugars ; refining in manufactory. Colonial sugars ; commercial kinds. Fiscal régime of sugars. Artificial sugar or saccharine.
Alcohol.—Ethylic alcohol. Commercial alcohols ; raw materials : wines, marcs, fruits, seeds, potatoes, etc. ; head, middle and end fractions, rectification. Denomination and commercial types : trois-six, cognac, tafia, rum, gin, kirsch, etc.
Impurities ; denaturation. Statistics.
Æther, methylic alcohol, chloroform.
Spirituous liquors.—Wines, white, red, sparkling, etc. Sucrage (putting sugar in), vinage, plastering. Diseases of vines, treatment ; pasteurisation. French and foreign wines.
Wines and raisins. Cider, perry. Statistics.
Beer.[1]—Raw materials : malt, specialised industry of maltage. Yeasts ; production and examination. Beers with high and low fermentation. Hops, various kinds. Beers under carbonic pressure.
Adulterations, falsifications. Examination.
Regulation of the trade in spirituous liquors. Excise documents, receipts and expenditure.
Vinegar. Wine vinegar, acetic acid, etc.
Crystallisable acetic acid, pyroligneous acid, pyrolignite of iron.
Chemical products.—Oxalic and citric acids ; tartaric substances, artificial colouring matters ; raw materials : benzene, naphthaline, anthracene. Products obtained therefrom.
Vegetable textile substances.

Products of Animal Origin.

Living Animals.—Fairs and markets, customs, "*cas rédhibitoire*" (rendering a sale null and void). Trade of importation and exploitation ; statistics.
Slaughtered meat.—Hides, offal. Cold storage, conservation, importation. Salt provisions. Statistics.
Fisheries.—Fresh and salt fish, etc.
Products and skins and hides of animals.—Furriery. Raw hides. Tanning ; new methods ; tanned, curried, tawed, dressed, hides, etc. Parchment, shagreen, etc.
Bone, ivory, whalebone, horsehair, hair, wool, floss, feathers, horn, scales. Fancy turnery, trade.
Nacre, pearl, coral, sponge.

Animal Textile Matters.

Fatty substances.—Fat, tallow, fish oil, cod-liver oil, spermaceti, wax.
Candles, stearic acid, wax candles.
Soaps. Glycerine, oleic acid.
Milk ; concentrated milk. Butter, cheese, sugar of milk, oleo-margarine, regulation.
Various matters.—Cochineal, musk. Gelatine, glue : various commercial kinds, fish-glue and isinglass.
Manures.—Natural, chemical, compound manures. Manure, dried blood, *tontisse.* Products of equarrissage (the flaying and cutting up of horses), fish. Estimation of the value of manures.
Explosive materials.—Black and white powders, shooting powder, blasting powder, cannon powders. Gun-cotton, celluloid powder, nitro-glycerine, picrates, dynamite, gelatinised gun-cotton and nitro-glycerine, etc., etc. Regulations.

25. *Laboratory Work.*—The laboratory work and practical experimentation cover the following range, viz. :—

(1) Complete exact analysis. Analysis of determinate elements. So-called commercial analyses by purely conventional methods. Current experiments. Practical examinations of merchandise ;
(2) Great importance of the handling of average specimens ;
(3) Employment of the magnifying glass, the microscope, etc ;

[1] There are six special lectures on Brewery given at the Institut Pasteur.

(4) Determination of humidity. Condition. Heating over, balance ;
(5) Point of fusion, of ebullition. Tension of vapour. Thermometer ;
(6) Employment of areometers of conventional graduation ; densimeters : description and graduation of the most important. Correction for temperature ;
(7) Employment of displacement apparatus ;
(8) Ideas concerning the employment of titrated solutions.

Practical Experiments.

(1) Qualitative essay of water. Hydrotimetry ;
(2) Testing of potashes and sodas. Alkalimetry ;
(3) Decolorant chlorides ;
(4) Testing of petroleums, density, vapour, tension, inflammability ;
(5) Alcoholometry ;
(6) Testing of wines, beers, vinegars ;
(7) Testing of milk ;
(8) Testing of the farinas ; determination of the gluten. Microscopic examination ;
(9) Testing of the sugars ; examination of the glucose ; saccharometry ;
(10) Crystallisation ; principal forms of crystals ; examination of the most widely distributed crystallised substances ;
(11) Determination of the solubilities of substances.

26. *Economic Geography* (2 years).—The course in economic geography is essentially practical. It is well organised. For each country it is concerned with the following subjects, viz. :—

Character of the Course.

(1) Aperçu of the territorial formation. Population. Ethnography. Languages. Religions. Political institutions, great administrative divisions.

(2) General configuration and nature of the soil. Climates.

(3) Products of agriculture. Breeding of cattle. Forestry exploitation. Agricultural regions. Hunting and fishing.

(4) Mineral products. Mines and quarries. Salt mines. Mineral sources.

(5) Manufactures. Centres of industry. Their origin and their *raison d'être.*

(6) Ways of communication. Navigable streams and rivers. Canals. Roads and railways. Marine navigation. Ports. The mercantile navy. Navigation companies. Postal services. Telegraphic services.

(7) External commerce. Principal markets. Various reasons of their prosperity. Importations and exportations. Commercial customs. Special study of the commerce of each country with France, and the competition which French commerce encounters there.

(8) Customs régime. Commercial treaties. Weights and measures. Coins. Credit institutions.

(9) Social state. Morals and national character.

Europe. France. The British Isles. German Empire. Holland. Belgium. Alsace-Lorraine. Switzerland. Austria-Hungary. Spain. Portugal. Italy. The Danubian States and the Balkan Peninsula. Greece. Russia. Scandinavian States.

France in Northern Africa—Algeria—Physical and economic geography, peopling, régime of lands, public works, administration, budget. *Régime douanier.*

Tunis.—Development of colonisation, agriculture and commerce, *régime douanier* (customs) and commercial treaties, duties, function of the Protectorate.

The religious and native question in Algeria and Tunis.

(I) *Africa.*—General conceptions. Explorations. The European conquest. The Berlin Conference, 1885. The treaties of 1890. Great lines of navigation.

The Atlas region. The Empire of Morocco. The Regency of Tripoli. The Sahara. Islam and its religious brotherhoods. Caravan routes. The plans of the Trans-Saharian Railway.

The islands of the Atlantic Ocean. The coasts of Guinea and the Soudan. Senegal and French Soudan.

Niger and Lake Tchad. The English Company of the Niger. French, English, and German settlements of the Guinea coast.

The basin of the Congo and the Western coast. French Congo. The Independent States. The Portuguese colonies and the German West.

Southern Africa. The Cape and Natal. The Orange Free State. South African River.

Eastern Africa. Zambesi. The English South African Company. Mozambique. The great lakes. The English and German Companies. Zanzibar.

The Somali coast. The Gulf of Aden and the Red Sea. English possessions. Obock. The Italians in Africa. Abyssinia.

The Valley of the Nile. Egypt. The Suez Canal.

The islands of the Indian Ocean. Madagascar. The Comores and the Union. The English possessions.

(II) *Asia*—General ideas, races and religions, political divisions. High roads of terrestrial and maritime communications.

Western Asia. Turkey in Asia and Arabia.

The plateau of Iran. Persia. Afghanistan, Baluchistan.

Russian Asia. Caucasus. Central Asia or Russian Turkestan. Siberia.

The English possessions. The Indian Empire. Ceylon, the Straits. French India.

Further India. Burmah. Kingdom of Siam. French Further India. Cochin China. Camboja. Annam. Tonquin.

The Far East. Chinese Empire. Korea. Japan.

(III) *Oceania.*—General ideas. Great voyages of explorations. Physical divisions.

Malay. Dutch, English, and Spanish possessions.

British Australasia. Australia. Tasmania. New Zealand. Fiji Islands.

The French possessions. New Caledonia. French settlements of Oceania. The Germans, English, and Americans in Polynesia.

The Hawaiian Islands.

(IV) *America.*—General ideas. Historical summary of the discoveries and voyages to the North Pole.

North America. Political divisions. Transcontinental and oceanic high roads of communication.

The British possessions of North America. Dominion of Canada. Newfoundland . fisheries. Saint Peter and Miquelon.

The United States. Mexico. Central America. The five Republics and British Honduras. The Isthmus of Panama. The Antilles.

South America. Venezuela. Colombia and the Equator. Peru. Bolivia and Chili. The Argentine Republic, Paraguay, Uraguay. Brazil. The Guianas.

27. *History of Commerce* (2nd year).—The development of this subject, so important from the liberal point of view, and calculated to enable a merchant to look out on business affairs with a mind of large horizon, is as follows :—

(I) The sources and the systematic study of commercial history. General survey of commerce in antiquity. Commerce of the Mediterranean. Commerce outside the Mediterranean before and during the Roman Empire.

General survey of commerce in the Middle Ages. Markets and fairs. Corporations. Mediterranean and Hanseatic commerce.

Geographical knowledge in the 15th century. Maritime discoveries. Colonial empires of Portugal and Spain. Economic results of the Renaissance and the Reformation. The commerce of the Netherlands and England in the 16th and the 17th century.

The commerce of France in the 16th and 17th century. Richelieu, Colbert. The Companies. Internal régime.

The commerce and the colonies of France and England in the 18th century.

The new economic doctrines. The brilliant despotism.

The French Revolution ; the Napoleonic régime and the continental blockade ; their economic consequences

(II) Commerce in the 19th century.

General conditions of commerce from 1815 to 1848.

France from 1815 to 1848. Protectionist policy. Influence of the "*régime parlementaire censitaire.*" The Corn Laws. The Free-trade movement under Louis-Philippe. Public works. Agriculture, industry. Credit institutions. Transformation of the Press. Colonial policy.

England. Its social, political, and economic régime before the great reforms. The Corn Laws. Rise of the Manchester School. Political and economic reforms. The India Companies.

Germany and the Zollverein.

Other countries of Europe from 1815 to 1848.

(III) New conditions of commerce since 1848.

(1) Political changes : democracy. Subordination of politics to the material interests of the people.

(2) Material changes. Science applied to industry. Increase of production, cheapness and diversity of manufactured articles. Roads of transport and communication. Boats and railways. Suez Canal. Development of voyages and emigration. Metals and credit : banks, societies, clearing-houses. Statistics and commercial intelligence. Horary System. The telegraph and telephone.

The commerce of France from 1848 to 1870. Decay of free-trade ideas during the second Republic. Napoleon III and his ideas. Commercial Treaties. Railway and navigation laws. Colonial policy. Exhibition of 1867 and progress of French industry. Advancement of viticulture. Free-trade in grain. Protectionist agitation.

War of 1870. Financial and economic policy of Thiers. The tariffs of 1881 and the new commercial treaties. Economic crisis ; return to protection : tariffs of 1892 ; conventions with Switzerland and Italy.

External and colonial commerce of contemporary France.

Democratic England. Imperialist ideas.

Germany. Considerable progress of her industry and commerce since 1870 ; their causes.

Austria-Hungary. Predominance of Hungary. Economic development of Bohemia.

Italy. Its political unity. Its progress and taxes.

Russia. Internal régime : Emancipation of the serfs. Tariffs of 1887. The Eastern Policy ; the Russian railways.

Other States of contemporary Europe.

(IV) The new markets and the industrial centres in course of formation :—

Asia. Caravan trade. Maritime commerce. Transformation of Japan. The Chinese question.

Africa. Political divisions. New ways and new elements of commerce. South Africa.

Australasia. English colonies of Australia ; New Zealand.

Modern America. United States :—

(1) Formation of territory, and the population. The economico-political parties. The races.

(2) Development of production and transports. External relations. Customs duties.

English America : Canada ; economic progress.

Central America. Cuba. The Antilles.

The Latin States of America. History. Economic development.

(V) General view of the development of commerce. Present condition of the commercial world and international situation.

Interest and utility of the economic history.

28. *Political Economy* (2nd year).—This subject is developed on the following lines, viz. :—

Preliminary Ideas.

Aperçu of the economic phænomena. Science and art in political economy. The method : Importance of observation, historic criticism, experimentation, statistics and its principal numerical and geographical processes.

Production.

The three factors of production :—

(1) *Natural Agents.*—The land and the law of non-proportional productiveness.

(2) *Labour.*—Division of labour. Freedom of labour. Slavery. Servitude. Corporations. Regulation.

(3) *Capital.*—Its formation, its rôle, its various forms. Machines : their effects :—

Classification of industries. Important and unimportant industries.

(1) *Agricultural Industry.*—Extensive and intensive culture ; large and small cultivation ; improvement ; rent ; *métayage* (leasing farms on condition that the farmer shall give to the owner a settled portion of the produce). (2) *Extractive Industries ;* (3) *Manufacturing Industry ;* (4) *Commercial Industry ;* (5) *Carrying Industry.*—Economic rôle of transports. Roads, canals, maritime ways, ports, railways. Régime of transports by railway in the principal countries (exploitation by the State, monopoly conceded to companies, farmers' associations, régime of simple "*reglementation.*" Economic systems of fixation of tariffs in the principal countries. Régime of ports. Subsidised companies. Economic transformations resulting from the progress of transports.

Circulation

Exchange and Value.—Current and normal value. Competition and monopolies.

Mechanism of Exchange :—

Money.—The two rôles that it should fill. Qualities which a good coin should present. The principal coins : gold silver, bullion. Principal features of the history of precious metals and their values.

Monetary systems. Legal currency. Gresham's laws. Paper-money. Depreciation of silver, its causes and effects. American Silver Bill. Latin Union. Mono-metallism and bimetallism. Present state of the question everywhere. Effects of the depreciation of money on international commerce.

Credit—Its utility. Advantages and securities offered by the borrower to the lender.

Commercial credit. Fiduciary circulation. The bourses of public and other bills of exchange. The Exchange. Banks : rôle of bankers, discount, deposits, accounts-current, cheques, transfers, clearing house. Banks of Issue, their relations with the State, their régime in the principal countries.

Mortgaged credit. Crédit Foncier. Marine mortgage. Credit on security. Loans on title-deeds, warrants, mont-de-piété.

Agricultural credit. Popular banks. Various systems.

Commerce.—Internal and external commerce. Rôle of intermediate agents. Wholesale and retail trade. Speculation. Monopoly.

Law concerning markets. Crises : theories of crises.

Colonisation.

Colonisation.

Various kinds of colonies. Commercial advantages of colonisation. Conditions of development of colonies : preparation, lands, laws, recruiting of workmanship, the régime of the financier, government and administration. Rôles of the great colonising companies. Historic glance at the various systems adopted by the principal colonising peoples.

Distribution.

Individual Property.—How it is established. Its economic advantages. Its legitimacy. Transmission : donations, sale, heritage. The common patrimony.

Freedom of Contracts.—Annuity, income. Interest : decline of interest, its causes and effects. Regulation of interest. *Salary.* Salary funds, productivity of labour. Various forms of salaries, premiums, participation in the profits. Profits of the contractor.

Consumption.

Productive and unproductive consumptions. Economy and prodigality. Luxury. Absenteeism. Public consumption.

Population.

Malthus and his doctrines. Pauperism : causes and remedies. Economy. Insurance. Assistance.

The State.

Its rôle in the economic order. Its intervention. National and international reglementation. Socialism.

29. *Elements of Public Law, Civil Law and Commercial and Marine Legislation* (2 years).—These courses, which are very well developed, are treated as hereunder :—

(I.) *General ideas of French Public and Civil Law.*

Organisation of public powers : legislative power ; executive power ; promulgation of the law. Judiciary power : organisation of the various jurisdictions, especially of the tribunals of commerce and of "*conseils de prud'hommes*" (council of experts, of the most experienced masters and workmen of a calling or trade, whose task it is to decide all disputes). Commercial representation : Higher Council of commerce and industry ; chambers of commerce ; design of creation of chambers of navigation ; consultative chambers of arts and manufactures ; French and foreign chambers of commerce. Consuls.

Civil laws. Concerning nationality, the condition of foreigners in France. Records of the civil state. Domicile, Marriage. Paternity and affiliation. Paternal power. Minority, tutelage and emancipation. Interdiction and the judicial council.

Personal and real property. Property and possession. Usufruct and servitudes.

Various modes of acquisition of property. Successions. Settlements by living persons and bequests by testament. Contracts and obligations. Proof of the obligations. The Marriage Contract. Hiring. Trusts. Giving security. Transactions. Privileges and mortgages. Prescription.

(II.) *Commercial Legislation.*

General conceptions concerning commerce and commercial law. Sources of French commercial law. Table of commercial legislations at present in force in the principal foreign countries. Codes and laws to be consulted : bibliography. Necessity for the unification of certain subjects of commercial law ; attempts at unification ; international congresses.

Commercial Documents.—Interest in distinguishing them (competency, proof, etc.).

Merchants.—Capacity (minors ; married women). Obligations and rights : commercial books, publicity of the Marriage Contract, licenses, elections and eligibility to the tribunals and chambers of commerce. Foreign commercial register.

Competency of the tribunals of commerce. Ideas of procedure. "*Arbitrage.*"

Companies.—General ideas : civil and commercial companies. Companies in collective name and simple limited joint-stock company. Joint-stock companies in general. Generalities concerning shares and obligations, the documents transferable or to bearer. Premium and mutual insurance societies. Societies with circulating capital (co-operative societies). Partnerships. Civil companies with commercial forms. Régime of joint-stock companies in the principal foreign countries. Foreign companies in France.

Intermediate Agents employed by Merchants.—Private attorneys (ideas concerning foreign legislations). Custom or excise officers. Clerks. Factors and proxies. Brokers.

The Commercial Sale.—General rules concerning its conclusion and effects. Different kinds.

Gages.—Civil and Commercial gage. Special rules concerning the commercial gage. General warehouses, warrants and receipts.

Transport Contract.—General rules. Transport by railway. Berne Convention. Transports by post ; international conventions.

Commercial Exchange.—Operations which take place in exchanges. Stock-brokers and brokers.

Commercial Effects.

Bill of Exchange.—History. Theory of the French code and principal foreign legislations. The form of the bill of exchange. Endorsement, its forms and effects. Provision. Acceptance. Rights and duties of the bearer.

Cheques—Their distinctive characters. English legislation. Clearing-houses of London and the United States. Chamber of Compensation of Paris.

Bills to Order.—Bills of settlement.

Recovery of Commercial Effects by the administration of the post-offices in France and in the principal foreign countries. Bills payable to bearer.

Banking operations.—Loan. Discount. Rate of interest. Overtures of credit. Account-current. The Bank of France colonial banks, Credit Foncier.

Insolvency, Judicial Liquidation and Bankruptcy—Insolvency in the principal foreign legislations ; insolvency of merchants ; preventive measures against insolvency.

(III.) *Navigation Laws.*

General ideas. Sources of marine law.

Vessels.—Ship-holders and "*armateurs.*" Rights of various creditors : privilege, mortgages, law of precedence. Abandonment of the ship and freight.

Chartering or Freighting.—Distinction between general and particular averages. Rules of York and Antwerp.

Bottomry.—Marine mortgage.

Marine Insurances.—General ideas. Special rules in personal and property insurance.

Appendix.—General ideas concerning fire, accident, and life insurances.

30. *Industrial and Labour Legislation* (2nd year).—This course is developed as follows :—

Industrial Law.

Patents.—Concerning the nature of the law devoted to the benefit of the inventor. Patent, its character, formalities, publicity. The patentability of inventions. Nullities. Forfeitures. Duration and tax on the patents. Improvement. The importation of an invention patented in a foreign country. Claims of foreigners. Provisional protection during public exhibitions. The ownership of the invention and patent. Various laws of which the patent may be the object. The surrender and transmission of patents. Concessions of licenses. Forgery. Jurisdiction and shares. Action in nullity. Action in forfeiture. Action relative to the ownership of patents. Action in forgery, procedure, repression. Secrets of forging.

Manufacturing

Manufacturing Models and Designs.—General ideas concerning artistic property.

Manufacturer's and trade marks. Character of the marks. Optional and obligatory marks. Property. Transmission. Depôt. Forgery. Repression.

Commercial Name.—Names of locality (products coming from foreign lands).

Unfair Competition.

Foreign Legislations in affairs of industrial property.

Rights of Foreigners in affairs of industrial property.

International Conventions (Union of 1883, etc.).

Dangerous, unhealthy or inconvenient factories, etc. . legal régime. Régime of apparatus and boilers, etc.

Labour Legislation.

Contract of the hiring of services. Professional syndicates. Co-operative Societies of production, consumption, of construction and credit. Coalitions. Conciliation and "*arbitrage.*" Privileges relative to salaries; protected against seizure; modes and periods of payment of salaries.

Apprenticeship. Regulation of the work of children, women, and adults. Accidents to works, responsibilities; professional risks; industrial societies for the prevention of accidents. Laws or legislative questions concerning the savings bank, old-age pension fund, insurances, societies of mutual help, etc., etc. Ideas of comparative legislation.

31. *Fiscal and Customs Legislation* (2nd year).—This course, belonging to the 2nd year only, is developed as follows:—

Budget Legislation.—The State budget. Origin and history of the public finances. Preparation, vote, execution of the budget. Extraordinary and supplementary credits.

Public Expenditure.—Ministerial credits, financial administration and public accountancy. The public debts. Amortization. Conversions. The progression of the budgets. The resources of the budget.

Public Revenues.—The public and private domain of the State. The railways.

Taxes.—General ideas concerning the tax. Its nature. Its characters and economic consequences. Its influence on industry and commerce.

The single and multiple tax.

Proportional and progressive taxes. Tax on capital. Income tax. Assessed tax. Indirect tax. The expenses of collecting.

Assessed taxes: Land tax, tax on personal property, the tax on doors and windows, licenses.

Income tax on personal values. Taxes on luxuries.

Indirect taxes: Registering and stamp duties, custom-duties, and statistics, etc.

Taxes on consumption. The proceeds of the Post Office, and taxes on transport. General organisation of the postal and telegraphic service.

Local taxes. Budgets of the "*départements*" and "*communes.*" Grants.

The reduction of taxes.

Financial organisation and fiscal legislation of the principal foreign countries: England, Germany, Austria-Hungary, Italy, Russia, Turkey, the United States of America, etc.

Customs Legislation.—Successive changes in the Customs legislation to the present time. Present régime. The French tariffs. The principal foreign tariffs. Commercial treaties in force.

The Administration of the Customs. Double character of the duties collected by it. Fiscal duties. Protective duties. Theory of compensative duties.

General and conventional tariff. Respective advantages of these two forms of Customs legislation. Condition of the most favoured nation.

Modes of taxation. Specific duties. *Ad valorem* duties. Drawbacks. Temporary admissions. Exportation premiums (bonuses).

Division of custom-duties. Importation and exportation duties. Transit duties. Accessory duties collected by the Administration of the Customs. Its co-operation in the recovery of certain internal taxes.

Police measures and security against fraud. Active service of the Customs. Frontier radius of land and sea. Indication of the proceedings and methods of recourse in contentious Customs affairs. Duties of pre-emption, etc.

Commercial statistics. General commerce. Special commerce. Customs evaluations. Official values Present values. Influence of prices. Raw materials. Manufactured products.

Special régimes. Régimes of the colonies.

Customs legislation of the principal industries. Trade in grain. Extractive and manufacturing industries. Sugars. Tax on salt. Maritime fishing, etc.

The Mercantile Navy. Preferential duties. Additional taxes of "*pavillon.*" Additional taxes of bonded warehouse. Premiums of navigation and "*armement.*" Construction premiums.

Commercial policy and Customs tariffs of the principal States.

32. *Transports and Plant* (1st year).—The course in these subjects is thus developed:—

(I.) *Transports.*

Establishment, Maintenance, and Administration of the Ways of Communication. Judicial situation of the ways of communication. "*Domanialité.*"

Establishment of ways of communication by the State, the "*départements*" or the "*communes.*" Concessions.

Present development of the roads, canals, navigable ways, and maritime ports. Costs of establishment and maintenance.

History of the net-work of French railways. Financial relations of the companies with the State. The State railway. Railway of local interest. Present state of the French net-work. The control of the State concerning railways with grants.

Judicial characters of the tariffs and conditions of their establishment.

Economic Study of Transports.—Value of transports and net cost.

Influence of the tolls on the development of traffic and the utility of the ways of communication.

Ready-reckoners and fixed tariffs; their advantages and inconveniences.

Cost of transports by road or water, its variability. Present importance of traffic.

Net costs of transports by railway. Elements of variation of net cost. Fixed tariff and ready-reckoner. Representative turns of the tariffs. Present importance of traffic.

Competition in transport affairs, and principally between railways and navigation. The so-called tariffs "*de pénétration.*"

Special Study of Railway Tariffs.—Generalities concerning railway tariffs; usage of the "*Recueil Chaix.*" Ready-reckoners and graphic representation. Distance of application. Fixed tariffs. Conditions of the unnamed intermediate stations, etc. Tariffs of travellers. Classes, tickets of voyage out and in, excursion tickets, compartment fees (*places de luxes*). Luggage.

General tariffs of express and goods train. Conditions of application and delay. Classification.

Exceptional tariff. Accessory expenses.

Special tariffs. Conditions of application of these tariffs.

Porterage and carting. Relations of railway enterprises with the other transport enterprises.

(II.)

(II.) *Machinery of Commerce.*

Ideas concerning Mechanics.—Velocity and acceleration. Force. Mass. Work and *vis viva.* Mechanical units. Mechanical equivalent of heat. Energy: its transformations and conservation. Sources of energy.

Study of the principal motors. Living motors. Motors utilising the force of the wind. Hydraulic wheels. Turbines. Detailed study of the steam-engine and its latest improvements; generators of steam; regulation and administrative surveillance. Gas and petroleum engines. Various motors. Mechanism by which motion is transmitted and transformed.

Various dynamometers and indicators.

Telegraphy.—Principles of electro-magnetic telegraphy. Aerial and subterannean lines. Detailed study of the Morse system. Setting up of a telegraphic post; lightning conductor, galvanometer, electric bell. Dial-plate apparatus. Comparison of the two systems. Rapid apparatus. Monopoly and irresponsibility of the State in telegraphic matters. Constitution of the French net-work; so-called *municipal* bureaux; semaphores; pneumatic net-work of Paris. Taxes. International communications; terrestrial and submarine lines. International telegraphic union. Cyphered telegrams; cryptography. Private lines.

Telephony.—Description and function of Bell's telephone. Microphone: description and function of a microtelephonic system. Setting of the telephonic posts. Effects of induction between adjacent telegraphic and telephonic currents: means of contending against them. Comparison of the respective advantages and inconveniences of the telegraph and telephone. State monopoly: its limits. Organisation of telephonic communications in the interior of a closed property, between the different divisions of an industrial or commercial establishment. Private telephonic lines. Urban net-works and groups of urban net-works. Telephonic communications at long distances.

Electric Lighting.—Ideas concerning Ohm's law and electric units: *ohm, volt, ampère.* Voltmeters and ampère-meters. Abstract theory of the Gramme machine. Magneto and dynamo-electric machines, with continuous current and alternating current, accumulators. Electric arc lamps; regulators; Jablochkoff candle. Incandescent electric lamps. Selection to be made between the arc lamps and incandescent, according to circumstances. Accumulators.

Distribution of Electric Light.—By direct or transformed currents. Lighting of railway stations, markets, the great industrial, commercial, or financial establishments.

Domestic lighting; study of a certain number of installations. Various advantages resulting from the use of electric light. Cost of electric lighting compared with that of gas. Future of electric light, its competition with gas.

Electric Transmission of Force.—The most important systems. Experiments and applications. Electric traction.

Regulation and administrative surveillance of the lines and works of industrial electricity.

Hoisting Apparatus.—Various types of hand-hoists, pulley-blocks, wood and metal, and of fixed or variable range. Steam hoists with or without gears; Chrétien hoist. Steam cranes; organisation of the transports in the Creuzot works. Cranes working by water under pressure; Armstrong's system of hydraulic cranes. Steam windlasses and cranes for discharging railway carriages or river boats, etc. Inclined planes with railway carriages.

Railways.—Comparison between the traction of a vehicle on an ordinary road and on a railroad: necessity for modifying the slopes and curves. Multiple conditions of the laying out of a great line of railway.

Ordinary road with double circulation. Sleepers; iron and steel rails, etc. Variations of track: points, crossings, etc. Level crossings. Turn-tables, hand or steam.

Rolling-stock for the transport of merchandise. Construction of a train, of a railway carriage. Different types of railway-carriages: closed carriages, etc.; carriages with platforms. Freight limit. Gauge. Transport of large pieces of wood. Special carriages and trucks. Goods platforms. Small stations. Principal stations. Goods receiving offices. Special cranes employed therein. Large stations at junctions for shunting, etc. Classification by gravity (inclined plane of Edge Hill). Terminal stations, the general arrangement (examples, Batignolles, Bercy, etc.). Detailed description of the "*Gare de la Chapelle.*" Management of railway-carriages: manœuvres by hand and with horses; machinery for management; hydraulic capstans. Coaling stations. Platform for ironwork and stones.

Particular branches. Conditions of establishment and exploitation; administrative formalities.

Narrow-gauge railways. Facilities of laying out and economy of construction of the road and material; examples. Terminal junctions with the principal line; plant for the transhipment of goods.

Small railroads for works, mercantile establishments, and general warehouses. Tramways. Portable railways.

Interior Navigation.—Means of transport on streams, rivers, and canals; forms and dimensions of boats. Various methods of locomotion: Hand towage, towage by means of horses, experiment with steam towage. Sail navigation. Steam navigation; paddle and screw boats; lighters and tugs; towing boats; rafts, lumber, etc.

Canalisation of rivers; weirs; locks. Lateral canals. Canals with branches. Their feeding. Inclined planes of the Morris canal; inclined plane of Blackhill. Elevator of the Great Western; Anderton elevator; elevator of the Fontinettes.

Ports for navigation of the interior.

Seaports.—The maritime towns and struggles between them; progress achieved each day in the management of ports.

Operations to which merchandise is subject, from the ship's hold to the placing in the railway carriages or entrance into the warehouse and *vice versâ.* Co-ordination between land and sea installations. Ocean ports: dock-gates, floating-docks, mean-tide docks, tidal docks, deep-water docks. Seaports without tide: works performed at sea. Piers, external embankments. Description of a typical port according to M. Barret. Piers or wharves destined for steamers transporting dispatches, passengers, and merchandise of value; sheds and store-houses; railroads. Piers for the exclusive purpose of transport of merchandise. Special wharves for the exportation and importation of heavy and bulky merchandise. Holds for wood. Piers on piles: New York. Wharves of docks, their maintenance. Marine station. Quay of the external dyke. Transhipment from ship to ship. Hoisting apparatus of wharves: movable cranes operated by water under pressure. Floating steam-cranes. Hand, steam, and hydraulic caissons. Utilisation of water under pressure for operating swing-bridges, towing capstans, etc.

Unloading of cereals: Floating pneumatic elevator apparatus at Bordeaux.

Installations of repairs: careening docks, towage, floating docks, transferable docks, dry docks.

London and Liverpool docks. Docks for the exportation of coal: Northumberland dock and Tyne dock.

Detailed description of the ports of Trieste, Marseilles, Havre, and Antwerp.

Bonded and General Warehouses.—Buildings of several stories and buildings of one story only; advantages and inconveniences of each type. Construction and management. Elevators; hydraulic freight-loading; unloading. Constructions for the purpose of receiving special merchandise. Spirits. Wines. Vegetable oils. Rock oils. Warehousing of grain: Pits for preserving grain, and various granaries. Condition.

33.—*Organic Chemistry* (1st year).—This subject is, of course, orientated commercially, but covers a wide range, and one which is clearly commercially valuable. The details of development are as follows:—

Generalities.—Presence of carbon in the organic compounds. Binary, ternary, and quaternary compounds.

Immediate principles. Formation under the influence of life, by synthesis.

Elementary analysis; immediate analysis.

Summary ideas concerning chemical formulæ: empirical formulæ; atoms, molecules, atomicities, formulæ representative of molecular grouping. Substitutions.

Starch substances.—Amidon, fecula; protetic substances, gluten; separation, properties. Dextrine, glucose. Diastase.

Cellulose.—Properties. Vegetable parchment. Gun-cotton, collodion, celluloid, artificial silk.

Paper.—Manufacture.

Sugar or Saccharose.—Properties. Sugar-cane: manufacture. Sugar of beet: manufacture, refining, molasses. Extraction of sugar from molasses by osmosis, and by using strontian. Sugar of milk.

Fermentation.—Production of new substances under the influence of yeasts and ferments.

Alcoholic fermentation; manufacture of wine, cider, beer, and alcohol. Acetic fermentation; vinegar.

Ethylic

Ethylic Alcohol.—Properties ; uses, alcoholometry.
Æthers, aldehydes ; acetic acid, chloral ; methylic alcohol, chloroform, formic acid, amylic alcohol, valeric acid.
Hydrogen Carbides.—Summary ideas concerning the rôle played by the carbides of hydrogen in the series of organic bodies.
Ethylene or marsh gas ; acetylene.
Illuminating gas ; manufacture, distillation of tar. Mineral oils ; benzene, paraffin, naphthaline, anthracene.
Derivative products ; aniline colours, etc.
Essential oil of turpentine, caoutchouc ; gutta-percha ; camphor.
Fatty Substances.—Extraction of oils, purifications. Properties, use. Tallow, animal fats.
Soaps : raw materials, saponification, different kinds of soaps.
Stearine candles ; preparation of the fatty acids by saponification : (1) by heat ; (2) by sulphuric acid.
Organic Acids.—Oxalic, tartaric, citric acids ; gallic acid, tannins.
Alkaloids of opium, the cinchonas, strychnine, etc.
Albuminoid matters.—Albumin, gelatine.
Animal Products.—Blood, saliva, bile, etc. Milk, butter, cheese.

34. *Trade in Textiles, Threads, and Fabrics* (2nd year).—The following is the scheme of development for the course relating to commerce in textile goods. It is fairly comprehensive:—

Generalities concerning Textile Fibres.—Qualities which they should exhibit. Materials of vegetable, animal, or mineral origin. Determination of their nature : chemical and microscopic characters.
Threads.—Formation of threads. Simple, twisted, cabled threads, etc. Numbering. Samples of threads. Condition of raw materials and threads.
Flax.—Study of flax, various varieties. Culture, retting, stripping. Producing countries : France, Belgium, Holland, Russia, etc. Commerce of flax, commercial usages, statistics.
Other fibres.—Hemp, jute. ramie, etc.
Cotton.—Study of cotton. Culture, shelling, mode of packing and despatch. Short and long fibres. Classification of cottons according to productions and qualities. Principal markets, commercial customs, statistics.
Wool.—Study of wool. Breeding, and the breeds of sheep. Shearings ; short, long and fine wools ; washing. Indigenous wools of America, Australia, etc. Principal markets, commercial customs, statistics.
Other Animal hair.—Goat's hair, angora, cashmere, alpaca, etc.
Silk.—Eggs, "magnaneries" ; production and commerce in cocoons. Country producers, commercial customs, statistics. Products analogous to silk.
Spinning.—General ideas. *Spinning of Flax.*—Preparation : Carding, combing, stretching. Dry and moist spinning. Glossing, packing up. Stopping, wastes. Spinning of the succedanea of flax.
Spinning of Cotton.—Preparation : openers, beaters, carding, combing. Spinning.
Spinning of Wool.—Preparation : winding-off, greasing, washing, "*ensimage*," carding, combing. Spinning. Standardising. Treatment of the wash.
Spinning of Silk.—Silk-milling, raw silk, wastes, "*schappe*," standardising the silk.
Weaving.—General ideas concerning the manufacture of textile fabrics. Nomenclature and denomination of the various kinds of jute, cotton jute materials, etc. ; wool, silk, and mixtures.
Fundamental "*armures*," representation, decomposition. Preparation : Warping, sizing.
Weaving, hand and mechanical looms ; mechanics of "*armures.*" Jacquard looms.
Preparations. Special study of linen and cotton cloths, cloths and woollen stuffs, velvets and carpets, silk materials, tulles, laces, passementerie, etc., etc.
Fixing of net costs, commercial and industrial statistics.
Bleaching of threads and tissues.—Flax, cotton, wool, silk.
Dyeing.—General ideas. Classification of colours. General process of dyeing. Mordants, principal colouring matters. Density of various dyes. Printing on the materials. Preparation, surcharges. Experiments.

35. *Caligraphy* (1st year).—In this subject there is a recapitulation of the general principles relative to the various kinds of writing, with both theoretical and practical exercises. There is also the usual application of writing to correspondence and commercial accountancy, to business letters, to commercial bills, invoices, writing, transferred from the day-book to the ledger, to inventories, balance-sheets, and discount bills, etc., etc.

Administrative documents, synoptic tables, memoranda, etc., are prepared, and foreign commercial correspondence undertaken.

36. *French.* (2 years).—The course in French includes a complete recapitulation of the grammar under the form of interrogations and written exercises. A practical study of the difficulties of orthography is made, analytical dictation is a feature, and etymology and the family relationship of words is studied. There are, too, exercises of redaction and style, as well as correspondence with respect to the ordinary subjects, business letters, etc. This gives a notion of how practically the subject is orientated.

37. *Concluding Remarks.*—A reading of the above programme is a sufficient revelation of the thoroughness of the course in commercial subjects in the Higher School of Commerce of Lille.

It has been given *in extenso* for the express purpose of disclosing the real nature of the course, and of shewing the thorough way in which a syllabus for the guidance of the French instructor is developed.

CHAPTER LVI.

CHAPTER LVI.

The Higher School of Commerce of Marseilles, France.

[G. H. KNIBBS.]

1. *Introduction.*—The Higher School of Commerce of Marseilles (*Ecole supérieure de Commerce de Marseille*) was established on 15th October, 1872, and is under the patronage of the Chamber of Commerce of the city, and, further, is specially recognised by the State.[1]

At a meeting of the Chamber of Commerce, held on 30th November, 1871, the question of its creation was first mooted. The merchants of Marseilles recognised that in commercial education France was lamentably behind hand.

Belgium had taken action in the same matter as early as 1852. Mulhouse had already been six years in the field. Germany had for many years endeavoured to meet the wants of its citizens in the way of commercial education.

The bitterness of the then recent disaster of France had compelled her thoughtful citizens to recognise exactly where her limitations lay, and she was not slow to perceive that *her defeat was the consequence of German educational superiority.*[2] It was seen that it was little use reorganising the army, if at the same time education and the general habits of the people were not also modified.[3] It was stated that only by the demonstration of a sufficient vitality would it be possible for the country to recover its moral and material equilibrium.

The causes of the backward condition of commercial education were carefully considered. The importance of modern languages, of good accountancy, of better methods in commercial arithmetic, and of commercial geography, were vividly recognised. The features of commercial education in various countries were thoroughly studied.

The Commission dealing with the whole matter appointed a sub-committee, and the latter drew up a programme of studies and a general scheme of organisation. The original "*Statuts*" have since been modified, viz., by an extraordinary general meeting, held 15th December, 1898. This modification is expressed under six sections with forty articles, which it is unnecessary, however, to detail.

2. *Organisation of School of Commerce.*—Originally in the rue Ste Victoire, the School of Commerce of Marseilles was transferred, 1st October, 1891, to the rue Paradis, 181.

On the ground-floor there are nine rooms ; on the first floor, an amphitheatre and three class-rooms; on the second floor four class-rooms; besides which there are numerous other rooms on the third floor, and in the cellars, etc., available for the work of the school.

In addition to the above, there are quarters also for a limited number of resident students.

3. *Pædagogic Organisation.*—The duration of the technical studies proper is two years, as in the Lille school, and the minimum age of admission is 15 to the preparatory year, or 16 to the course proper. For admission to the preparatory year pupils must *write legibly*, with a correct French *style* and *orthography*, and possess the following preliminary knowledge, viz. :—

(i) *Arithmetic.*—Four rules, fractions, metric system, proportion, interest and discount.
(ii) First elements of *algebra.*
(iii) *Geometry.*—Elementary conceptions of perpendicular, oblique, and parallel lines, triangles, polygons, circles, the areas of plane surfaces.
(iv) *Geography.*—The principal divisions of the continents, and France.
(v) *History.*—General history of France.

Foreign pupils are admitted as irregular students (*auditeurs*) until their knowledge of French permits them to be received as regular students (*élèves*). The preparatory year is occupied as follows :—

Programme of the Preparatory Year "Ecole supérieure de Commerce de Marseille."

Subjects.	Hours per week.		Subjects.	Hours per week.	
	Commerce.	Marine.		Commerce.	Marine.
French	5	5	Chemistry	2	2
Language (English)	5	5	Physics	2	...
2nd „ (modern)	1	...	Geometry	2	3
Accountancy	2	2	Caligraphy	2	2
General Geography	3	3	Physics and Mechanics... ...	...	3
History	1	1	Plane Trigonometry	...	1
Arithmetic and Algebra... ...	7	7			
			Totals	32	34

[1] Décrets du 22 juillet, 1890 ; 27 juillet, 1892

[2] "In the report of M. Courtot, on the proposal to found the school, it is said :—'Avant de nous vaincre par les armes, l'étranger nous avait déjà vaincus par l'instruction, dont le développment était favorisé chez lui par tous les moyens.'"

[3] "Ce ne serait donc pas assez pour la France de réorganiser son armée et de fortifier ses places de guerre si, en même temps, nous ne travaillons pas à la régénération de notre pays et si nous ne modifions pas, dans nos habitudes, dans nos mœurs et dans notre instruction, ce qu'il y a de défectueux et d'incomplet."

An

An examination is held at the end of the year, the scheme of marking is the same, excepting that 85 per cent. is reckoned "good," instead of "very good," as at Lille; 50 per cent. are necessary to proceed to the course in Commerce proper. The conditions for *foreign pupils* are the same as for French, but a limited number may attend as irregular students.

There are the Commerce and "Marine" sections, and a Colonial section in the regular school.

4. *Programme of the Sections.*—The programmes of the sections are necessary to exhibit the general outline of the courses. Since 1899 they have taken the following forms, taking first the Commercial Section.

Programmes of the "Ecole supèrieure de Commerce, Marseille," Commercial Section.

Subjects.	Years and Hours per Week. I.	II.
Commerce and Accountancy ... ... } Mathematics applied to Commerce .. .. }	11	10
English	5	4
A second Language	3	3
Merchandise	3	3
Economic Geography	3	3
Commercial, Maritime and Industrial Legislation	2	2
Labour, Fiscal and Customs Legislation	1	1
Political Economy, History of Commerce	...	1
Marine "*Armements*"[1]	...	2
French and Commercial Correspondence	2	2
Caligraphy	2	2
"*Conferences*"	...	3
Totals	32	36

The "Marine" Section has the following programme, viz.:—

Section "de la Marine."

Subjects.	Years and Hours per Week. I.	II.
Commerce and Accountancy	1	1
Legislation	1	1
English	3	3
French, Correspondence, etc.	2	1
Caligraphy	1	...
Physics and Chemistry	1	1
Geometry and Trigonometry	2	2
Arithmetic and Algebra	2	2
Drawing	2	2
Geography	2	2
Maritime History of France	...	1
Naval Mechanics—theory and practice	3	2
Manœuvres and Rigging. Physics of the Globe	2	2
Cosmography, Navigation, and Nautical Calculation	4	6
Mechanics and the Steam-engine	2	2
Practical Exercises	4	4
Totals	32	32

The programme of the *Colonial Section* is as follows:—

Colonial Section.

Subjects (Ordinary).	Years and Hours per Week. I.	II.	Subjects (Special).	Years and Hours per Week. I.	II.
Commerce and Accountancy ... } Mathematics applied to Commerce }	11	10	Colonial Vegetable, Animal, and Mineral Products.	3	3
English	5	4	Colonial Geography	...	2
A second Language	3	3	Colonial Legislation	...	2
Economic Geography	3	3	History of Colonisation ...	...	1
Commercial and Maritime Legislation	2	2	Hygiene of Warm Climates ...	...	1
French and Commercial Correspondence.	2	2			
Caligraphy	2	2	Totals	31	35

[1] The "*Armement*" is the material and equipment of a vessel.

5.

5. *Certificates and Diplomas.*—Two diplomas are conferred (A) and (B), the former being given to the higher four-fifths of those who have obtained at least 65 per cent. of the total marks, the remainder receiving the latter (B).

A "*certificat d'études*" is given to the remaining pupils, French or foreign, who have received 55 per cent., "*attestations d'études*" are given to "*auditeurs*," French or foreign, who have worked satisfactorily. Gold and silver medals (the former of the value of £8) are awarded, the gold to the first and second pupils in the Commercial and Marine Sections, and the silver to every student receiving the diploma.

6. *Function of the School.*—The school is deemed to provide suitable education, outside its direct preparation for a commercial career, for the diplomatic and consular careers, and those who possess the diploma of the school are admitted to the consulates as "*élèves chanceliers.*" The office of "*redacteur*" in the Ministry of Commerce and Industry is open to the graduates, and in the examination for admission to the Customs administration the diploma counts for one-sixth of the marks. The diploma also grants relief in respect of compulsory military service in the same way as in the Lille school.

7. *Details of the Courses.*—It is already evident that the organisation of the Marseilles school is different from that of Lille. In order to disclose the nature of the curriculum, an outline is necessary of the way in which each subject is taken. This will not agree exactly with that of the Lille school, because it is independently organised. The following details are therefore of interest to anyone who cares to really study French commercial education. The work for the different sections is given.

8. *Commerce and Accountancy, Commercial Section, 1st and 2nd years.*—The course in the 1st and 2nd years of the Commercial Section in Commerce and Accountancy is developed as follows:—

A.—THE COMMERCIAL SECTION.

First Year.

Commerce and Accountancy.

Commerce.—Classification of merchants. Brokers.

Documents relating to Exchange.—Various kinds of invoices, purchases and sales account. Expenses. Various documents.

Documents relating to Transports.—Invoices. Declarations of despatch. Railway receipts. Bills of lading. Charter-party. Insurance policy.

Exchange Regulations.—Money. Bank-notes. Paper money. Cash bonds. Commercial effects: Bills of exchange, promissory note, bill payable to bearer. Mandate. Cheque. Clearing-house. House of Compensation.

Banks.—Usual operations. Discount. Deposits. Bourse orders. Overtures of credit; business which involves them. Trade quotations.

Merchandise Exchange.—Disposable commercial sales. Commercial sales for ship delivery. Cost, freight, and insurance (c.i.f.). Steady markets. Markets at a premium. Liquidation.

Elements and general theory of Accountancy.—Ledgers and auxiliary books. Classification of accounts. Analysis of their various series.

Book-keeping. Monographies.—The keeping of merchants' books. Stock-book. Liquidation. Consignations and participations.

Mathematics applied to Commerce and Banking.

Mental and short methods of calculation.

Interest and Discount.—Theory and application of fixed divisors, of aliquot parts. Commercial and mathematical discount.

Complex numbers.—Addition, subtraction, multiplication and division. Calculation of taxes. Conversion of moneys. Abbreviated calcluations.

Bills discounted.—Bills discounted in the Bank of France and in private banks. Relation of commissions and interest.

Mean Maturity.—Direct mean maturity. Inverse mean maturity. Reverse mean maturity. Average maturity.

Accounts-current and Interest.—Direct method by immediate interest, by numbers. The old Hamburg method—New—accounts-current with preferential rates. Accounts-current with variations of rates agreed upon for a fixed time. Fixed for each change of rate.

Net Costs and Parities.—Fictitious net accounts. Construction and use of net scales. Tables of freight variations. Parities in merchandise. Method of calculating them. Use of the conjoined rule. Practical applications. "Arbitrages" in regard to merchandise.

Compound Interest.—General formulæ. Investments of intermittent duration. Discount with compound interest. Mean and average maturity with compound interest. Use of numerical tables.

Annuities.—Investment annuities. Annuities of amortization. Loans on obligations.

Second Year.

Commerce and Accountancy.

Ideas regarding Commercial Management.—Organisation of a mercantile establishment. Capital necessary for enterprises. Management of businesses. Moral and material conditions for their success.

Exchange Values.—Rate of exchange. Public funds. Shares and obligations. Public loans. Amortizations and conversions. Official quotations of brokers. "*Parquet*" and "*Coulisse*" (unauthorised part of the exchange): their transactions. Taxes and stamps. "*Report.*" "*Déport.*"

Railway Tariffs.—Various categories of tariffs. Ready-reckoner. Graphical representations. Distances of application. Fixed tariffs and their correctives. General collection of the tariffs. Reading of the tariffs. Conditions of application. Packet-post. The Berne Convention.

Post and Telegraph Offices.—Taxes. Payments, International communications. Telegraphic codes. Telephone.

Wharves

Wharves and depôts.—Shipping and landing of merchandise. Negotiations on deposited merchandise. Receipt. Warrant. Real and fictitious depôts. The warrant and the Customs House.

Custom and Excise Duties.—Powers of the administration of Customs. Classification of the duties. Régime of merchandise. Custom-house tariffs. Declarations. Mode of acquittal of duties. Temporary admissions. Traffic in "*Acquits à caution.*" Excise. Régime of spirituous liquors.

Marine Insurance.—Policy. Premiums. Insurable commodities. Action taken in cases of abandonment and damage. Laws of York and Antwerp. Franchises and series. Laws concerning particular and general averages with applications. Accountancy with regard to marine insurances.

Banking Accountancy.—Banking transactions. Accountancy. Duties of banks, portfolio, standards, deposits, advances, accounts-current. Balances and balance-sheets. Financial participations.

Industrial Accountancy.—Classification of works to be accounted for. Accounts of construction. Accounts of manufacture relative to a series of isolated works. Manufacturing accounts relative to a work continued with successive conversions of raw material. Workshop accounts. Extant accounts. Permanence of the inventory. Balances. Balance-sheets. Evaluation of the capital necessary for an industry. Relation between the set charges and production. Administration of great industrial enterprises.

Accountancy pertaining to the "Armement."—Accounts of vessels, of voyages, of maintenance and repairs, of insurances, of reservations, of consignees. Balance-sheet of a navigation company.

Mathematics applied to Commerce and to Banking.

Exchange.—Method of negotiation by exchange. Variations in the prices. Conversions by exchange. Current exchange. Paris quotation. "Arbitrage" of exchanges. "Arbitrage" of bills and trading places. "Arbitrages" of debt and credit, of purchase and sale, speculation. Examination of parity ("*cote chiffrée*") and of net-cost. Bank-orders. Study of exchange when the relations are at par intrinsically. Application to the resolution of the calculations of "arbitrages."

Precious metals and moneys.—Quotations of bullion. Commercial relation of gold and silver. Alloys. Standards. Various kinds of metallic and fiduciary coins. Bank of France and Bank of England. Clearing-houses and Chambers of Compensation. Monetary systems: (*a*) France. Latin Union. Countries having adopted the French monetary system. (*b*) Countries where the monetary system is based on the decimal system. (*c*) Countries where it is based on the duodecimal system. Monometallism and bimetallism. Gold Points. Parities of Gold Points.

The Bourse.—Exercises concerning Bourse transactions. Graphical representation of purchases, sales, the position of payers and receivers of premiums, of firm operations against premiums and premiums against premiums. Scale of premiums. Speculator's note-book. Quotation of foreign values. Arbitrations of these values. Fixed combined exchange, "Arbitrages" on continuations.

Operations of Insurance Companies.—Tables of Mortality. Ideas regarding probabilities. Life-annuities. Immediate. Deferred. Temporary. Life insurances.

9. *Modern Languages, Commercial Section.*—English is an obligatory language in the Commercial school. The following remarks will sufficiently indicate the nature of the course:—

FIRST YEAR.

Modern Languages.

English (*obligatory*).—Ordinary parlance, idiomatic phrases, commercial terms. Free conversations between professor and pupils. Grammar. Syntax.

Arabic, German, Spanish, Modern Greek, Italian, Russian (The second language is optional).—Frequent conversational exercises. Technical expressions and terms employed in commerce. Reading and translation of the commercial course. Grammar. Syntax.

SECOND YEAR.

Modern Languages.

English (obligatory), and *Arabic, German, Spanish, Modern Greek, Italian, Russian* (The second language is optional).—Continuation of the first-year course. Study of the grammatical difficulties. Commercial correspondence. Circulars. Reading of manuscript letters. Technical conversation between professor and pupils on a subject already studied and explained.

10. *Merchandise, Commercial Section.*—The course in this subject is orientated as indicated hereunder:—

FIRST YEAR.

Merchandise.

Mineral Kingdom.—Minerals. Metals. Materials of construction. Limestones, cements, etc. Rock-oils, coal, various combustibles. Chemical industry. Mineral dyes. Chemical manures.

Vegetable Kingdom.—Wood and timbers. Oil seeds. Grain-oils. Olive oil. Soap trade. Vegetable waxes. Drugs. Vegetable dyes.

Animal Kingdom.—Fats. Stearine. Butters. Tallows and lards. Feet and fish oils. Animal wax. Remains of animals (skins, hides, etc.).

SECOND YEAR.

Merchandise.

Vegetable Kingdom,—Cereals. Legumes. Feculents. Commercial feculæ. Wheat, rye, etc. Farinas. Sugars. Coffees. Cocoas. Peppers. Vanilla. Teas. Tobacco. Cottons. Flax and hemp. Grain alcohols. Wines. Beer. Cider.

Animal Kingdom.—Hides and skins. Wools. Cocoons. Silks. Summary of ideas concerning spinning.

The products are studied from a commercial rather than an industrial point of view. The studies are completed by visits to the principal works of the district.

11.

11. *Economic Geography, Commercial Section.*—This subject, of great practical importance, is well developed, as the outline hereunder shews:—

FIRST YEAR.

Economic Geography.

General ideas of Cosmography, Meteorology, and Cartography.
Study of France.—Recapitulation of physical geography.
Agriculture.—Cultures. Meadows. Forests. Cattle. Fishing. Value of agricultural production. Extractive industries. Metallurgics. Textiles. Aliments. Chemicals, etc. Value of industrial production. *Internal commerce.* Transports. Markets. *External commerce.* General and special commerce. Commercial treaties. Merchant-service. Movement of navigation. Laws of 1881 and 1893. Bill of 1899. French *colonies.* Concern of France in the commerce of her colonies. Her rank among the colonial powers. Ideas concerning administrative geography.
Other countries of Europe.—Same division as for France. The United Kingdom of Great Britain and Ireland. Germany. Austria. Hungary. Belgium. The Netherlands. Switzerland. Italy. Spain. Portugal. Scandinavia. Russia. Balkans. Roumania. Bulgaria. Servia. Montenegro. Turkey in Europe. Greece.

SECOND YEAR.

Economic Geography.

French Africa.—Algeria, Tunis, situation, surface, and populations. Relief, natural regions, coasts, climate, and agriculture. Mines, quarries, and industries. Ways of communication. Principal markets. Foreign commerce. Maritime trade. Stations in the extreme south. French markets in the south of Algeria. Touat. Saharia. Trans-Sahara projects.
Western Africa.—Senegal. Soudan. French Guinea. The Ivory Coast. Dahomey. France and England in Western Africa. Anglo-French convention of 1890. Anglo-French agreements of 14th June, 1898, and 21st March, 1899.
Congo. Oubanghi. France at Bahr-el-Ghazal and at Lake Tchad.
Islands of the Indian Ocean. Madagascar and dependencies. Réunion.
French Coast of the Somali.
English Africa.—Colonies on the West Coast. South Africa. Protectorate of Central Africa. East Africa. Zanzibar. Egypt. Egyptian Soudan. Islands of the Indian Ocean. Mauritius, etc. Britannic Somali.
Africa (various possessions).—German Africa. Cameroons and Hinterland of the Amadaoua. South-East Africa. German Eastern Africa.
Portuguese Africa.—Archipelagoes of the Azores, Madeira and Cape Verd. Portuguese Guinea. Islands in the Gulf of Guinea. Colony of Angola. Mozambique.
Belgian Congo.—Productions. Ways of communication. Commerce and trading companies. *Turkish possessions.* Tripoli. Routes and caravans to the Soudan. *Italian possessions.* Italian colony of Erythrea. Protectorate of the Italian coast of the Somali. *Spanish possessions.* Presidios. The Canary Islands. Spanish Islands of the Gulf of Guinea.
Independent Africa.—Morocco. Abyssinia. The Republic of Liberia. Republics of the Transvaal and the Orange Free State.
Asia.—*Russia,* Siberia, Caucasus. *Turkey,* Asia Minor, Armenia, Syria, Palestine, Arabia. *Plateau of the Yran.* Persia. Afghanistan. Baluchistan.
British.—British India. Ceylon. Burmah. Straits Settlements. Hong Kong. *French.* Settlements of the French Indies: French Further India. Cochin China. Tonquin. Anam. Cambodia.
Eastern Asia.—Recent European acquisitions in China: Port Arthur. Wei-Hai-Wei. Kiao-Tchéou. Quang-Tchéou.
East Indian Isles.—The Philippines. The islands belonging to the Netherlands.
Oceania.—Australasia. The continent of Australia. Tasmania. New Zealand. Fiji. New Guinea. New Caledonia. New Hebrides. Polynesian Archipelagoes. French settlements of Oceania. The Hawaii or Sandwich Archipelago.
America.—United States. Recapitulation of physical geography. Agriculture. Mineral wealth. Metallurgy. Alimentary, textile industries, etc. Railways. Markets. Importations. Exportations. Maritime trade.
Dominion of Canada. Mexico. Central America. The Antilles.
South America.—Columbia. Venezuela. Guiana. Brazil. The La Plata Republics. Chili. Peru. Bolivia. Ecuador.

12. *Public and Civil Law, Commercial Section.*—The course in this belongs to the first year, and is as follows:—

Public and Civil Law.

Public and Administrative Law.—Great public powers. Judiciary organisation. Tribunals of Commerce. Consuls. Higher Council of Commerce and Industry. Chambers of Commerce.
Civil Law.—Possession and exercise of civil rights. Successions. Testaments. Contracts and obligations. Proof. Sale. Hire.

13. *Legislation in regard to Industry and Labour, Commercial Section.*—These first-year courses deal with the following matters, viz.:—

Legislation affecting Industry and Labour.

Industrial Law.—Patents. Manufacturer's and trade marks. Commercial names and signs. Literary and artistic property. Dangerous establishments.
Legislation relating to Workmen.—Deed of apprenticeship. Wages. Dismissals. Garnishments. Professional syndicates. Coalitions. Conciliations. Strikes. Accidents.

14.

14. *Legislation affecting Commerce, Sea-trade, Fiscal Question, the Customs—Commercial Section.*—The important matters are treated as shewn hereunder, and are dealt with in the second year only:—

Commercial, Marine, Fiscal and Custom-house Legislation.

Commercial Law.—Sources of commercial law. Traders and commercial records. Commercial accounts. Intermediate agents. Commercial security. Transports. Commercial effects. Commercial sales. Clearing-houses and Houses of Compensation. Liquidation. Rehabilitation. Bankruptcy.
Marine Law.—Sources of marine law. Vessels and shipowners. Captains and crews. Responsibilities. Marine mortgage. Freight contracts. Bottomry. Marine insurances.
Fiscal and Custom-house Legislation.—The budget of the State, of the Départements, communes and public establishments. Direct and indirect taxes. State monopolies. Registering. Stamp. Customs. Tariffs. Commercial treaties. Free-trade and protection. Bonds. Docks. General warehouses.

15. *Political Economy and the History of Commerce—Commercial Section.*—These also are second-year subjects, and developed as follows:—

Political Economy and History of Commerce.

Political Economy.—Production. Circulation. Colonisation. Distribution. Consumption. The population and the State.
History of Commerce.—Economic rôle of commerce. Influence of commerce on civilisation. Commerce in ancient times. Commerce in the Middle Ages. Commerce in modern times. Colonial system. Commercial treaties. Economic transformations.

16. *French, Caligraphy, etc.—Commercial Section.*—These subjects are treated as hereunder:—

First Year.

French Commercial Correspondence.—Rapid recapitulation of the Grammar. Orthographical difficulties. Analytical study of punctuation based on logical analysis. Simple commercial letters; transmission of a command. Forwarding of documents and notices of issue of bills; delivery of commercial effects, domiciliations, interventions, drafts on account, unpaid returns, renewals, letters of recommendation, circulars, etc.
Writing.—Exercises on the different styles of writing.

Second Year.

French and Commercial Correspondence.—Commercial correspondence. Exchange of letters and telegrams relating to the conclusion of business treaties between natives and foreigners. Discussion of conditions serving as the basis of a series of operations. Overtures of credit. Consignments. Participations. Commercial intelligences. Terms used in the description of the state of a market. Litigious correspondence. Redaction of reports bearing on questions studied by the Chamber of Commerce of Marseilles; Custom-house taxes, public works, commercial legislation, etc.
Caligraphy.—Exercises on the different styles of writing. Application to book-keeping.

"*Conferences*" *in French.*

In these "conferences" the pupils in succession lecture to their comrades on various questions of accountancy, economical geography, merchandise, legislation, and political economy. The lectures are given before the director and the professors of the school.

The pupils have the intervals between the lectures for the preparation of questions on which they are to speak. Reading the lecture is interdicted, but very brief notes are permissible.

The very satisfactory results of these exercises have encouraged the authorities not only to maintain them, but to give them the fullest possible development.

17. "*Armement,*" *Commercial Section.*—This first-year course covers the following matters:—

"*Armement.*"

Principal shipbuilding yards. Description of the construction of wood and iron vessels. Decks, and compartments. Masts and rigging. Anchors and chains. Displacement. Tonnage. Registering companies. Steam-engines: boilers, bedding of machinery, shafting, propellers, and combustibles. Ship's Papers and various laws relating to the mercantile navy. Commercial routes. Visits during the year to shipbuilding yards, docks, etc.

18. "*Section de la Marine.*"—The above account completes the statement of the work done in the Commercial section. That done in the *Marine* section is very different in many respects. It will, therefore, be treated in detail, as in the previous section.

19. *Commerce and Accountancy, Marine Section.*—This subject is treated as follows:—

B.—THE MARINE SECTION.

First Year.

Commerce and Accountancy.

Commercial Arithmetic.—Short methods of calculations. Interest. Discount. Complex numbers. Operations on these numbers. Conversions. Mean maturity. Bills discounted. Accounts-current and interest.
Exchanges.—Purchases. Sales. Invoices. Regulation of exchanges. Coin. Effects of commerce. Returns.
Merchandise Exchange.—Its operations. Net cost. Parities. Practical applications.
Transports.—Various kinds of transports. Tariffs. Documents. Invoices. Bill of lading. Responsibility of captains and crews. Insurances. Charter-party. Freighting.
Book-keeping.—Terms concerning book-keeping. The account. Theory of general accounts. Auxiliary book-keeping, general book-keeping. Practical exercises of application. Balance. Inventory. Balance-sheet.

Second

SECOND YEAR.

Commerce and Accountancy. Mathematics applied to Commerce.—Custom-duty and Excise. Powers. Tariffs. Declarations. Regime of spirituous liquors. Various documents.

Docks and Bonded Warehouses.—Various exploitations. Receipts. Warrant. Real and fictitious depôts.

Marine Insurances. — Definitions. Classifications of averages. Rules of York and Antwerp. Exemptions and series. Laws concerning averages.

Post and Telegraph Offices.—Taxes. Packing of bills and invoices. International communications. Telegraphic orders. Telephone.

The Bourse.—Public funds. Shares and obligations. Parquet and Coulisse. Cash and term transactions.

General theory of Accountancy.—Analysis of various series of accounts. Organisation of books and accounts in the various kinds of companies.

Monographies.—Book-keeping for armament establishments.

Exchanges.—Exchanges. Rates of exchanges. Exercises on exchanges.

Precious metals.—Quotation of bullion. Coin. Minometallism and bimetallism. Monetary systems. Gold Points.

Compound Interest.—General formulæ. Investments of intermittent duration. Discount by compound interest. Numerical tables: their uses. *Annuities.* Investment annuities. Amortization annuities.

Insurances.—Tables of mortality. Life-annuities. Life-insurances.

20. *Commercial Legislation, Marine Section.*—This is a first-year course, and is developed as shewn hereunder :—

Commercial Legislation.

Public Law.—The Constitution. Organisation of public powers. Legislative power. Chamber of Deputies. Senate. Executive power. Promulgation of laws, Judiciary power: Organisation of the various jurisdictions, especially of tribunals of commerce and councils of experts. Commercial representation: of the Council of commerce and industry, of the Chambers of Commerce, of the French and foreign Chambers of Commerce. Project of the Chambers of Navigation, of consuls. Countries within and without Christendom; consular jurisdiction.

Civil Law.—Deeds of the civil state. Minority. Tutelage. Family councils. Ordinary testaments. Testaments on sea. The equality in partition. Reserve; the disposable share; representation. Authentic and private deeds. Testifying proof in civil and commercial law. Rent-lease.

Commercial Law.—General ideas regarding commerce and commercial law. Traders; commercial deeds; interest of *distinction.* Various kinds of trading companies. Companies in a collective name; limited joint-stock company. Joint-stock company; shares, obligations. Companies with a variable capital. Partnerships. Commercial brokers, ship-brokers; insurance ship-brokers. Bankruptcy; judiciary liquidation; bankruptcy.

21. *Maritime Legislation, Marine Section.*—This subject, of special importance to students of the section, is thus treated :—

Navigation Laws.

Maritime Law.—Maritime law in times of peace and in times of war. General ideas. Sources of maritime law. Vessels. Ship-holders and "*armateurs.*" Right of various creditors: privileges, mortgages, law of precedence; ordinary creditors. Abandonment of the vessel and of freight (jettisoning cargo). Chartering or freighting. Distinction between general and particular averages. Laws of York and Antwerp. Bottomry. Marine mortgage; general ideas.

General ideas regarding marine insurances. Special laws as to the insurance of persons and property. General ideas regarding fire, accident, and life insurances. Ship's Papers. Sea-affairs; marine registration. Commercial marine tribunals.

Freight: freightings. Stowage. Insurances. Custom-duty. Soundness. Naval hygiene. Ideas concerning the French and foreign sanitary police (decree of the 4th February, 1896).

Manifestos: Manifestos of destinations. Manifestos of transit. Consular manifestos. Manifestos of victualling.

22. *Languages, Writing, etc., Marine Section.*—These subjects are taken as indicated in the following statement :—

FIRST YEAR.

Modern Languages.—English (obligatory).—Conversational exercises. Grammar. Syntax. Correspondence.

French and Correspondence.—The same programme as for the Commercial Section, the course being common to both sections during the first year.

SECOND YEAR.

English.—Study of marine terms. Conversational exercises. Accounts of the sea. Grammar.

French and Acts relating to the Sea.—Sea-acts. Their utility. Legal dispositions relative to these documents; indications which they contain as to the form which should be given to them.

Log-book. Petitions and declarations lodged with the Consuls. Marine accounts.

Caligraphy. (Years 1 and 2).—Exercises on the different styles of writing; the course is common to both sections.

23. *Physics and Chemistry, Marine Section.*—The course covers two years, and is taken as shewn hereunder :—

FIRST YEAR.

Physics.

General Ideas. Hydrostatics.—Pascal's principle. Hydraulic press. General properties of heavy liquids in equilibrium. Archimedes' principle. Floating bodies. Densities. Specific weight. Determination of densities.

Statics of Gases.—Gravity. Atmospheric pressure. Barometers. Mariotte's law, manometers. Air-pump. Pumps. Syphons.

Calorics.—General effects. Thermometers. Co-efficients of dilatation. Changes of state. Solution, refrigerant mixtures. Formation of vapours. Ebullition. Evaporation. Distillation. Liquefaction of gases. Calorimeter. Radiation, conductivity.

Physics

Physics and Chemistry.

A. *Physics.*—Static electricity. Electric machines. Atmospheric electricity. Magnetism. Magnets. Laws of Poles. Action of the earth. Declination. Inclination. Process of magnetisation. Dynamic electricity. Law of contacts. Electric current. Intensity. Electromotive force. Resistance. Electric unities in use. Electro-magnetism. Action of currents on magnets and reciprocal actions. Electro-dynamics. Ampère's laws. Magnetisation by currents. Applications to telegraphy. Induction. Summary conceptions. Induction coil. Dynamo-electric machines. Telephones. Electric units.

B. *Chemistry.*—Laws. Nomenclature. Metalloids. Summary of ideas concerning oxygen and hydrogen compounds. Metals, generalities and properties. Metallic oxides. Salts. Bertholet's laws.

24. *Mathematics, Marine Section.*—The Mathematical courses are the following:—

First Year.

Geometry and Trigonometry.

Plane Geometry.—Straight line. Circumferences, similar figures. Measurement of areas.

Plane Trigonometry.—Trigonometrical lines. Trigonometrical tables. Solution of triangles.

Arithmetic and Algebra.

Elements of Arithmetic.—Numeration. Whole numbers, their properties. Vulgar fractions. Decimal numbers. Squares and square roots. Metric system. Ratios and applications.

Elements of Algebra.—Algebraic calculation. Equations of the 1st and 2nd degree. Progressions. Logarithms.

Second Year.

Geometry and Trigonometry.

Geometry of Space.—Straight lines and planes. Polyhedrons. Round bodies. Common curves. Ellipse. Axes. Parabola. Helix.

Spherical Trigonometry.—Fundamental relations between the elements of any spherical triangle whatsoever. Special relations relative to a right-angled spherical triangle. Solution of spherical triangles.

Arithmetic and Algebra.—Recapitulation of the first year's course. Algebraical calculation. Algebraical fractions. Powers. Roots. Radicles. Negative fractional and incommensurable exponents. Arrangements. Permutations. Combinations. Binomial theorem of Newton. Series. Functions. Logarithms considered as exponents. Ideas concerning derivatives.

25. *Drawing, Marine Section.*—The drawing in the first year is linear and free-hand sketches, and in the second year landscapes from copies and from Nature.

26. *Physical and Economic Geography, Marine Section.*—The courses are as follows:—

First Year.

Physical and Economic Geography.

The idea of general geography: The globe. Maps. Projections and developments. The sea. Oceans. Surface and depth. Tides. Winds and currents. The earth. The five continents.

Europe.—Relief. Hydrography. Monographs on the States of Europe. Surface. Population. Climate. Productions. Principal markets. Commerce. Trade of the various ports. The mercantile navy.

Second Year.

Physical and Economic Geography.

Europe.—English and Danish possessions.

Asia.—French, English, and Portuguese possessions.
Recent acquisitions of France, Russia, England, and Germany.
American protectorate of the Philippines.

Africa.—French, English, Portuguese, Spanish, Italian, Turkish, and German possessions.

America.—French, English, Dutch, Danish, and Spanish possessions.

Oceania.—French, English, Dutch, Ancient Spanish, German, and Portuguese possessions.

27. *Maritime History, Marine Section.*—This course belongs to both years, and is developed as indicated in the following programmes.

First Year.

Maritime History.

Colbert. The India Company. Classes. Marine guards. Progress in naval construction. Development of the Dutch power. The Dutch wars. Condition of the French American colonies before the war. Louis XIV. The Privateer War. Beginning of the decadence of the navy. The English at Gibraltar. Louis XV. Complete decadence. The Spanish War. Disloyal provocations on the part of England. Ruin of the royal navy. France and England in the Indian Ocean. Treaty of Aix-la-Chapelle. Contests in America. Continental war. Treaty of Paris. Loss of colonies.

Second

SECOND YEAR.

Efforts of Choiseul to rehabilitate the navy. Its restoration under Louis XVI. The ordinances of 1776. The Navy during the Revolution. The First Republic. The "*Directoire*." The Egyptian Expedition. The campaign of Bruix. The Consulat. Peace of Amiens. The Empire. The continental blockade. Treaty of Paris. The Navy of the Restoration. The steamship navy. Explorations in Oceania. English colonies. Conquest of India.

The Second Republic and the Second Empire. Armoured navy. Colonial expeditions. Last geographical discoveries. Progress of European colonisation.

28. *Naval Mechanics, Marine Section.*—The work in the first year touches the practical and in the second year the theoretical side of this subject. It treats of the following, viz. :—

FIRST YEAR.

Naval Mechanics (Practical).—Raw materials and principal shipbuilding yards. Estimate of construction and "*armement*." Inventory. Stocks. Wood and iron vessels. Decks and compartments. The hull and its accessories. Repairing docks. Floating docks and raising apparatus. Pumps, pulsometers. Embarkations. Tonnage. Register companies. Principles of stowage. Evolutions, etc.

SECOND YEAR.

Naval Mechanics (Theory).—Summary description of a vessel and plans of same. Displacement. Centre of keel; centre of gravity and metacentre; transversal and longitudinal stability. Indifferent stable, and unstable equilibrium. Effect of weight-carrying on stability. The vessel in motion. Stability under sail; rolling and pitching; straining of masts and rigging. Waves, rolling isochronous with the wave, reserve of stability; practical rules regarding stability. Rudder, evolutions, radii of evolution and of gyration.

29. *Manœuvring*[1] *and Rigging, Marine Section.*—This course belongs to both years. Its details are as follows:—

FIRST YEAR.

Manœuvring and Rigging.

The Nautical School for seamanship and rigging.—Masts, yards, ropes, blocks, tackles, sails, knots, anchors splices, anchoring and various other kinds of work.

Study of the rigging.—Putting in order. Manœuvring with sails.

Roadstead and sea rigging.—Manœuvres concerning masting. Anchors. Rowing and sailing boats. Ideas concerning the rigging of a sailing-ship.

Steering-school.—The compass-card. Ship's compass. Course-compass and its gimbals and binnacle. Ordinary log. Small patent log. Hand-line. Leadsman. Thomson sounder. Signals of the International Code.

SECOND YEAR.

Manœuvres with power.—Hawsers, their strength. Land apparatus for loading, etc. Punt or lighter. Apparatus on board. Tackle. Masting. Careening. Unshipping and hanging the rudder.

Anchors and cables.—Various models; manœuvring with same.

Theory of evolutions under sail.—Effect of wind on ships. Effect of resistance of water. Manœuvres with sailing vessels, with small boats, in embarkation.

Manœuvres of a steam-ship.—Various propellers. Towing.

Manœuvres in the case of bad weather.

Serious accidents to the rigging. Damages to, or loss of, rudder. Damages to the hull. Leaks. Running aground. Raising a sunken vessel. Ship afire. Lighting the ship. Rules of the road.

Physics of the Globe.—Régime of the winds. Atmospheric perturbations. Seas. Currents. Soundings, of great depth.

30. *Cosmography and Navigation, Marine Section.*—The courses include not only cosmography and navigation in a general sense, but also nautical computation. The following is an indication of the detail:—

FIRST YEAR.

Cosmography and Navigation.

Cosmography.—Preliminary. Definitions. Diurnal motion. Theodolite and equatorial telescope. Horizontal and equatorial co-ordinates. Actual form of the earth. Meridian instruments. Catalogues of stars. Celestial globes. The sun. Annual apparent motion. Ecliptic. Signs of the Zodiac. Ecliptic co-ordinates. The seasons. Ecliptic motion of the sun, law of areas. Precession of the equinoxes. Terrestrial zones. Twilight. Zodiacal light. Actual motion of the earth around the sun. Measurement of time. True time. Mean time. Sidereal time. Equations of time. Different kinds of years. Calendar. Moon and planets. Apparent motion of the moon in its orbit. Path of the nodes. Synodical and sidereal revolution. Phases. Spots and rotation. Eclipses of the moon and sun. Generalities concerning the planets.

Navigation by reckoning—Sea-charts. Theory and properties. Log. Compass. Courses. Formulæ of reckoning. Point and quarter point reduction tables. Problems of reckoning. Currents, Tides. Causes. Definitions. Tidal annual.

SECOND YEAR.

Cosmography, Navigation, and Nautical Computations.

Nautical Almanac.—To find the mean time interval between the transit of two stars. Meridian passages.

Sextant.—Theory and use. Artificial horizons. Corrections of altitudes.

Chronometer, regulation and use. Counters.

Triangle of position.—Calculation of time; favourable circumstances. Real and apparent rising and setting of a star.

Calculation

[1] This might be called "seamanship."

Calculation of latitude.—By the meridian; at any moment whatsoever, under favourable circumstances; by circummeridian and polar altitudes.

Calculation of azimuth.—Tables. Amplitude of the points of rising and setting.

Longitude by chronometers; circle, curve and line of altitude. Three methods of calculation.

Observed point.—By an horary altitude and the meridian or a circummeridian altitude; by two simultaneous or non-simultaneous altitudes; by the Lalande and Marcq Saint-Hilaire method.

Navigation without the chronometer.—Latitude from a meridian; regulation of the binnacle watch; variation by the amplitude of the sun, by the altitude of a star, by the tables of Labrosse, and by the pole-star.

Orthodromic navigation.—Angle of initial route and distant. Drawing of the great circle on the sea-chart. Regulation of the compass. Tables of deviation and compensation.

31. *Mechanics and the Steam-engine, Marine Section.*—The details of the two years are the following:—

FIRST YEAR.

Mechanics and Steam-engines.

Mechanics.—Statics. Forces, their measure; composition and decomposition of concurrent and parallel forces; moments of forces, gravity, centre of gravity, couples. Composition of any system of forces whatsoever applied to a solid body; condition of equilibrium; case where the solid body is obstructed by an obstacle. Lever, balance, pulley, differential pulley, wheel and axle and inclined plane; passive resistances.

Preliminary ideas.—Atmospheric air. Principle of the barometer. Water vapour. Vaporisation. Latent heat. Total heat of vaporisation. Tension. Expansion. Marriotte's law. Salt-water; its composition. Measure of concentration. Principle of Archimedes.

Description and Applied Mechanics.—Classification of marine engines. Summary review of the essential organs. Cylinders. Safety-valves. Jacketting. Slide-valves. Piston. Crank, and similar details of steam-engine.

Management and keeping in repair (damage).—Keeping the boilers filled. Firing. Damages to the boilers. Leaks. Fire. Means of draining a ship, etc., etc.

Conversion of one type of condenser into another.

Practical Exercises.

In order that these theoretical studies may have practical value, the pupils make weekly excursions, in the course of which they visit the principal merchantmen. They obtain exercise on the sea in the handling of the oar and the sail and various marine instruments, under the direction of a marine officer. They receive practical instruction in masting and seamanship on board the *Corvette de l'école des Mousses.*

SECOND YEAR.

Mechanics and Steam-engines.

Kinematics.—Movement about a point; velocity and acceleration; fall of bodies; curvilinear movement. Translation and rotation; velocity and angular acceleration. Moment of inertia.

Dynamics.—Law of inertia. Movement of a point subjected to the action of constant force. Mass. Quantity of movement. Work of forces. Theory of *vis viva.*

Description of Engines.—Various propellers. Evaporating apparatus. Various types of marine boilers. Accessories of boilers. Collectors. Purifiers. Dryers.

Water-pipes. Ensemble of a furnace. Smoke-stacks, etc. Apparatus of distribution. Pipes. Registers. Valves. Various slides. Various expansions and organs which produce them. Various condensers. Accessories of the condenser. Pumps and various auxiliary apparatus.

Applied Mechanics. Rapid reversing. Eccentric-wheels. Crank. Helices.

Work of the engines. Indicator. Various curves and their discussion. Work, evaluation of. Horse and horse-power. Steaming. Principle and working of the stearing-gear. Principle of the hydraulic apparatus; accumulators.

Practical Exercises.

Physical acclimatisation to a sea life. Various exercises in the masting of the *Corvette des Mousses* and in the rowing and sailing boats of the School.

This completes the course of the Marine Section.

32. *The Colonial Section.*—France deems the education of those who are to be directly occupied in her colonial possessions to be a matter of importance, and, consequently, the instruction in the Marseilles School of Commerce endeavours to supply an education specially adapted to the needs of those who are concerned in her colonial products.

The following programme is a sufficient indication of the work in the Colonial Section:—

Commerce and accountancy. Mathematics applied to commerce. English. Second languages. Economic geography. Commercial and maritime legislation. French and commercial correspondence. Caligraphy.

Colonial Products.

General ideas concerning climatology, geology, botanical geography, geography of the intertropical countries, considered from an agricultural point of view.

Oceanography. The great cold and hot streams of the Ocean; their action on vegetation. Causes of rain in intertropical regions. Cloud ring. Winter rains.

Land and sea breezes. Monsoons. Cyclones. Typhoons, etc.

Regions to windward and regions to leeward.

Vegetable

Vegetable Products.

Alimentary plants of warm countries.—Grains. Roots. Tubercles. Fruits. Vegetables. Sugar plants. Derivative industries. Manufacture of feculæ, sugar works, distilleries.
Aromatic spices.—Pepper, cloves, nutmeg, cinnamon bark, vanilla.
Stimulant and narcotic products.—Coffee, tea, kola, cocoa, opium, tobacco.
Textile fibres.—Long silk and short silk cottons. Jute, Ramie, Abaca, Hennequin.
Oleaginous grain and fruits.—Earth-nuts, sesames, cottons, oils, cabbage-trees, copras. Derivative industries: Soap-works, stearine works.
Gums and resins. Caoutc ouc and gutta-perchas. Woods and barks.

Animal Products.

Ivory. Ostrich feathers. Products of fishing: Fish, mother-of-pearl, pearls. Various industries: Icthyology. Cod-liver oil. Preserved fish.

Mineral Products.

Prospecting. Sodas. Metallic veins and alluvions. Quartz and auriferous alluvions. Placers. Nickel. Antimony. Chromium. Iron. Blast-furnaces. Mineral combustibles.

Selection of agricultural labourers for the warm countries. List of the comparative resistance of various races: Negroes, Chinese, Annamites, Malays, Hindoos, natives of New Hebrides, etc.

Colonial Geography.

Different kinds of colonies. Commercial advantages of colonisation. An historic glance at the various systems adopted by the principal colonisers. Reasons of their successes or failures. Rôle of the great colonising companies.

Detailed study of the principal French colonies from the point of view of the conditions of their economic development. Advantages offered to emigrants, régime of the lands, recruiting of manual labour, financial régime, government and administration. Hygiene.

Colonial Legislation.

General organisation of the colonies. Legislative régime; civil, commercial, industrial, and criminal laws. Political and administrative organisation; Governors, consuls généraux and colonial Commissions; municipal councils. Representation of the colonies in Parliament. Judiciary organisation; civil, criminal, and administrative justice. Financial organisation. Institutions of credit. Colonial banks. Special study of the organisation of certain colonies; Algeria, Tunis, Further India, Madagascar. Customs régime between the colonies and the metropolis. Commercial rôle of the consuls.

History of Colonisation.

Portuguese colonisation. Oils and the trade in spices. Spanish America and the commercial monopoly. Seville and Cadiz. Colonial France from 1515 to 1688.

First expeditions. Richelieu and Colbert. The great trading and colonising companies—in Holland, in England, and in France.

The wars between France and England. Choiseul's policy.

The United States and the Spanish Republics of South America. Contemporaneous colonial conceptions. Suppression of monopolies, of slavery, of the India Company. The methods of colonisation. Colonies of exploitation; Java (Holland). Indies (England). Cuba (Spain).

Colonies for peopling. Canada, The Cape, Australia (England). Rivalry between the Russians and the English in Asia. The Transcaspian. Colonial expansion of France in Africa and Asia (Algeria, Tunis, Further-India).

Exploration of Africa by France, England, Germany, Belgium, and Portugal.

Hygiene of Warm Countries.

Colonisation and hygiene. The climates of tropical countries. Hot climates and the human organism.
Departure for the colonies, voyage, arrival.
The new habitation; how should people eat and dress? Mode of existence. Work. Exercise.
Duties of the colonial citizen. Urban hygiene. Disease and convalescence.

33. *Evening and Sunday Courses.*—Besides the regular courses already referred to, there are evening courses from 8 to 9·30 p.m., and Sunday from 9 to 12 for mechanics, and for commercial employés from 8·30 to 10 p.m. The courses are as follow:—

Mechanicians.

Higher Course.—Mechanics, arithmetic, algebra, description of machinery, management of machinery.
Elementary Course.—Same subjects.
Sunday Course.—French, drawing, geometry, history, and geography.

Commercial Employés.

Evening Courses.—English, German, Italian, Spanish, commercial correspondence, French, caligraphy, stenography, commercial computations, accountancy, commercial law.

34. *Conclusion.*—The preceding courses shew the thoroughness of the French conception of what is necessary by way of Commercial education.

CHAPTER LVII.

CHAPTER LVII.

Commercial Education in Germany.

[J. W. TURNER.]

The commercial schools of Germany, not including the university grade, may be classified thus:—

Higher Grade.

I. Commercial schools whose diploma qualifies for a Freiwillige (one whose service in the army is limited to one year).

II. Realgymnasiums, realschulen, and technical schools having a special commercial section, and whose diploma qualifies for a Freiwillige.

Secondary Grade.

III. Commercial schools, with or without a section for commercial apprenticeship, whose diplomas do not qualify for the short term of army service.

IV. Commercial schools specially intended for apprentices who are already in business.

Group I.

Pupils enter the commercial schools of higher grade about the age of 14. The course extends over three years as a rule, but several schools have a four years' course. The hours of study per week in the regular course of these schools are never less than thirty, and in some cases reach as high as thirty-seven. Some of the higher grade commercial schools have several distinct divisions. The following, for example, is the organisation of courses in the Dresden Commercial Higher Grade School:—

1. Higher division.
2. Division for apprentices.
3. Commercial Course.
4. Higher Commercial Course.

Higher Division.

Pupils are not admitted to the higher division under 14 years of age. Their attainments must be equal to fourth-year standard of the realschule or realgymnasium. The course is for three years, following on a preparatory training. The time-table for the higher division is as follows:—

Dresden Commercial School—Higher Division.

Subjects.	Preparatory Course.	First Year Course.	Second Year Course.	Third Year Course.
Commercial Law	......	....	....	1
Science of Commerce	....	....	3	2
Commercial Correspondence	....	....	2	2
Book-keeping and Office Operations	....	2	3	2
Commercial Reckoning	5	5	3	3
German Language and Literature	4	4	3	3
French Language and Correspondence	4	4	4	4
English Language and Correspondence	4	4	4	4
General and Commercial Geography	3	2	2	2
General and Commercial History	3	2	2	3
Commercial and Political Economy	....	....	....	2
Chemistry	....	....	....	2
Technology	....	....	....	3
Physics	....	....	3	....
Natural History	3	3	....	....
Mathematics	3	3	3	2
Caligraphy	3	3	1	....
Drawing	....	1	1	1
Hours in the week	32	33	34	36
Italian } Optional	....	....	2	2
Stenography } Optional	....	2	2	2

Division

Division for Apprentices.

The minimum age for admission into this division is 14, and the educational qualification the primary instruction standard. The course for this class of students is one of four years—two years preparatory and two years special. The following is the time-table:—

Subjects.	Preparatory Course.	First Year Course.	Second Year Course.
Study of Commerce	....	1	1
Accountancy and Office Operations	1	1	1
Correspondence	....	....	1
Commercial Reckoning	3	2	2
German	3	2	1
Geography	1	2	2
Hours in the week	8	8	8
Study of Merchandise } Optional	....	....	1
French } Optional	....	2	2
English } Optional	....	2	2

Commercial Course.

The minimum age for admission to the Commercial Course is 14, and the qualification is the ordinary primary standard with French added. The course lasts one year, and is intended for those pupils who wish to acquire a training in certain theoretical knowledge before entering business. The following is the time-table:—

	Hours per week.
Study of Commerce, Exchange, Banking...	3
Accountancy and Office Operations	4
Correspondence	3
Commercial Reckoning	6
German	3
Commercial Geography	3
Study of Merchandise	3
French	5
Caligraphy	2
	32
Stenography (optional)	2

Higher Commercial Course.

The minimum age for admission to this division is 16. The course lasts for one year, and is intended for those who have completed their course in the realschule. The aim of such students is to become acquainted, in a short time, with the essentials of a business training. The following is the time-table for this division:—

	Hours per week.
Commercial Law	2
Study of Commerce and Political Economy	2
Commercial Correspondence	2
Accountancy	4
Commercial Reckoning	4
Technology, Study of Merchandise	3
History and Commercial Geography	3
	20
German Language and Literature } optional	4
English Language and Literature } optional	4
French Language and Correspondence } optional	4
	12

The Public Commercial School at Leipzig, founded by the Chamber of Commerce and subsidised by the Government, has three distinct divisions—(*a*) the higher school, with a course of three years, during which the hours of attendance per week are respectively 37, 35, 37; (*b*) a division for commercial apprentices, with a course of three years, ten hours' attendance per week; and (*c*) a special advanced commercial course, lasting one year, subdivided into two classes, viz., one for regular students who attend thirty hours each week, the other for commercial apprentices who spend eleven hours per week.

Other types of commercial schools existing in Germany are:—

(*a*) Those in which the studies are the same as in a realschule for the first three years, specialising in commerce during the last three.
(*b*) Those with a six years' course, hours ranging from thirty-one to thirty-five per week; age of admission, same as realschule.
(*c*) Those with a three years' preparatory course, 7 to 10 years of age, followed by the regular course of six years.

Group II.

Group II.

The realschulen of Germany are attended by boys who intend to follow a business career. The early years of the course are devoted to general instruction in modern languages, mathematics, natural sciences, geography, drawing, singing, gymnastics. In the latter years of the course the instruction becomes more special in character. The great feature of the realschulen is the splendid success realised in the teaching of modern languages. Mr. Consul Powell, in his most instructive report on commercial education in Germany, published at the end of 1898, says that his object in writing is "to make it apparent how widely and energetically the German nation is aroused to the necessity of commercial education as an important factor in their newly-developed competition with other trading nations, and especially is it noteworthy to remark how the study of modern languages is being encouraged and fostered by the nation at large."

The following is the time-table of the commercial section of the Ober-Realschule, Karlsruhe (1902):—

	Hours per week.
German—commercial correspondence	2
„ language	2
French—commercial correspondence	2
„ conversation	2
English—commercial correspondence	2
„ conversation	3
Book-keeping	2
Commercial science	2
„ arithmetic	3
„ geography	3
History	2
Stenography	2
Gymnastics	2
Italian	3
	32

Group III.

The lower grade commercial schools have courses designed for commercial apprenticeship. The age of admission is not less than 14, and the courses are for two or three years. The elementary division of the Commercial School at Hanover has five classes of six months each, held in early morning.

Group IV.

The schools coming under this class are specially intended for apprentices who are already in business. The courses are from two to four years, and students put in an attendance of ten to fifteen hours in the week, made up before 10 in the morning and after 6 in the evening. Apprentice schools are most numerous in Saxony, where attendance is compulsory after the completion of the primary school course. The subjects generally studied in Groups III and IV are modern languages, book-keeping, commercial arithmetic, commercial geography, and commercial correspondence.

The great German system of special commercial schools has no parallel in any other part of the world. Connected with the system are schools intended to meet the requirements and conditions of youths of varying ages, attainments, and opportunities. The lad apprenticed early, with a knowledge only of primary school subjects, is able to attend a commercial apprentice school some part of the day to learn more about his particular branch. The lad who is looking forward to apprenticeship, and who needs some special preparation, has no difficulty in obtaining the instruction he requires. The youth who desires to qualify for a good position in the business world can choose the realschule or the commercial school. The young man who seeks the highest business training, and who will hold a position of the greatest responsibility, may enter the Commercial High School, Leipzig—the Commercial University of Germany. A description of this institution follows:—

The Commercial High School, Leipzig.

Establishment.—The Commercial High School of Leipzig was established in 1898 by the Chamber of Commerce in Leipzig in conjunction with the Senate of the University. The Chamber of Commerce accepted all the financial liabilities for the first two years, but the Minister of the Interior and the City Council also contributed towards the support of the institution during that period.

Objects.—The Commercial High School exists for the following objects:—

(1) To give opportunity for deeper general and commercial education to grown-up young people who want to devote themselves to commerce, including banking, book-trade, etc.

(2) To give opportunity to teachers of commercial schools for the necessary theoretical and practical continuation of their education.

(3) To give opportunity to practical commercial men and members of related professions to expand their knowledge in special branches of commercial sciences.

Teaching Staff.—The teaching staff consists of three groups:—

(1) The professors and lecturers of the Leipzig University;

(2) The teachers of the Public Commercial School, Leipzig;

(3) Various special teachers of languages and special subjects.

As

As the students of the Commercial High School are allowed to hear all lectures held in the Leipzig University, a large field of general knowledge is open to them which they can extend according to their requirements. Since, too, the staff of the Public Commercial School, Leipzig, has been enlarged for the purposes of the High School, and is going to be further enlarged, a comprehensive and thorough technical training in all commercial subjects is guaranteed, and there is no fear that German students will lose the ground-work of a purely commercial education. This point has not been overlooked by the Director of Studies, who is mainly responsible for the syllabus of work.

Government.—The institution is, for the present, under the Minister of the Interior, but the management consists of a board composed of—

One representative of the Government;
One representative of the City Council of Leipzig;
The President of the Chamber of Commerce;
Two members of the Chamber of Commerce, in addition to the President;
Three University Professors, selected by the University Senate;
Two teachers of the Public Commercial School, selected by their Board;
The Director of Studies.

The Chairman of the Board is the President of the Chamber of Commerce.

In the engagement of special teachers, and in matters of material organisation, the consent of the Chamber of Commerce is necessary, but in all other points affecting the management of the institution the Board is free to act within its own constitution.

Director of Studies.—The Director of Studies is engaged for a term of two years by the Chamber of Commerce on the recommendation of the Board. Acting in conjunction with, and under the supervision of, the Board, he has the immediate management of the High School. Before the beginning of every half-yearly term it is his duty to consult the professors of the University whose lectures are included in the plan of studies, and also the other members of the teaching staff, and to arrange the time-table so as to give due consideration to all subjects.

Admission.—To do all the necessary work in connection with the admission of students to the High School the Board appoints two from among its own members—one a member of the Chamber of Commerce, the other a University professor—to act in conjunction with the Director of Studies and a representative of the Government as a Board of Matriculation. The Director of Studies is Chairman of this Board.

Conditions of Admission.—The conditions of admission to the Commercial High School, Leipzig, are:—

(1) *Abiturienten* from the German High Schools—nine years' course—gymnasium, realgymnasium, upper realschule.
(2) *Abiturienten* from Commercial High Schools—*i.e.*, such institutes whose highest class is on a level with the highest class of schools under (1).
(3) Teachers educated in seminaries who have passed their examinations.
(4) Commercial men who have passed the one-year military service examination and have finished their term of commercial apprenticeship.

These must prove their moral and intellectual fitness to the satisfaction of the Board of Matriculation. The Board also decides as to the fitness of foreign candidates applying for admission.

Applications.—Applicants for matriculation must apply personally, with necessary school references and certificates, to the Director of Studies within four weeks of the notification of a new term.

Candidate's Promise.—When the candidate has satisfied the Board of Matriculation, he signs a declaration that he will submit to the rules of the school, and as evidence of good faith he confirms his action by hand-shake with the Chairman of the Board. After these preliminaries are completed he receives his certificate of admission, called a matriculation card; identification card, containing Christian and surname, birth-place, and present lodging; book and programme of lectures, and hearer's card for attendance at the University. No student is allowed to attend both the University and the High School.

Plan of Studies.—The course of studies is calculated for four half-yearly terms. The subjects are:—

I. National Economy.

(1) General Political Economy, with a short supplementary course in the History of National Economy.
(2) Special Political Economy and Practical National Economy.
(3) Science of Finance.
(4) History of National Economy, especially History of Commerce.
(5) Social Politics, especially the Labour Question.

II.

II. Jurisprudence.

(1) Commercial, Bills, Marine Law—practical and written exercises in these subjects.
(2) International Law, especially for students who want to devote themselves to the consular service or intend to go into foreign countries.
(3) Bankruptcy Law.
(4) General fundamental doctrines of Law of Obligation.
(5) Law on Authorship, Copyright, Book Trade.
(6) Trades Law, Workmen's Assurance.

III. Geography.

Regular lectures are given in the University on General and Physical Geography, Political and Economical Geography, Ethnology, Sociology, Anthropology.

IV. Commercial Exercises.

(1) Correspondence and Office Work.
(2) Commercial Arithmetic.
(3) Political Arithmetic.
(4) Technology of Textile Industries.
(5) Chemical Technology.
(6) Book-keeping.
(7) Foreign Languages.
(8) Shorthand and Typewriting.

V. Pedagogic Lectures.

Students who wish to become teachers of commercial schools take up the course of pedagogic lectures in the Commercial School Teachers' Seminary, a branch of the Public Commercial School.

VI. General Education.

Students are advised to hear lectures held in the University in history, literature, art, modern languages, and natural sciences, but never to lose sight of the point that they must in no term take up too many lectures, as they are not only to hear, but properly digest, all the matter heard.

Fees.—The admission fee is twenty marks (£1) for Germans and fifty marks (£2 10s.) for foreigners. The matriculation card of the Commercial High School entitles the holder to a "hearer's" card at the University. For attendance at the University lectures and the seminary exercises of the University, the respective fees have to be paid to the Secretary of the University by the student. The fees for lectures and exercises in commercial sciences, foreign languages, etc., held outside the University, are settled by the High School Board, and are paid to the Secretary of the Chamber of Commerce. Such fees are not higher than those usually charged in German Universities. The students of the University at Leipzig are entitled to take part in all lectures and exercises held outside the University, as well as in the pedagogic seminary of the Commercial Public School, as "hearers," on taking out a "hearer's" card and paying the fees.

Persons of more advanced age, who, for some reason or other, cannot be received as matriculated students of the Commercial High School, may be admitted as "hearers" by the Director of Studies. The fee for such "hearer's" card is 4s. per half-yearly term. It does not entitle the holder to attendance at University lectures, for which a special "hearer's" card is necessary.

Classification of Students.—The subjoined table shows the classification of students (*a*) by schools, (*b*) by nationality :—

Winter term, 1902.	Germans.	Foreigners.	Total.
1. Abiturienten from Gymnasium	26	42	68
2. Do Realgymnasium	23	2	25
3. Do Upper Realschulen	2	4	6
4. Do Commercial Schools	3	42	45
5. Teachers educated in Seminaries	29	1	30
6. Commercial men with one year Military Certificate	139	34	173
7. From other professions	6	0	6
	228	125	353

Enrolment

Enrolment and ages.—The following table gives the enrolment and ages of students in 1902:—

	Germans.	Foreigners.	Total.
18 years	16	21	37
19 ,,	43	29	72
20 ,,	41	28	69
21 ,,	45	18	63
22 ,,	44	24	68
23 ,,	32	19	51
24 ,,	23	4	27
25 ,,	15	7	22
26 to 30 years	31	10	41
Over 30 ,,	12	7	19
	302	167	469

One hundred and sixteen of these left at the end of the summer term, bringing the total to 353, as above.

Homes of Students.—The following table shows the countries from which the High School attendance is drawn:—

German Empire.	
Prussia	160
Saxony	72
Anhalt	11
Baden	4
Bavaria	13
Brunswick	9
Alsace	1
Hamburg	2
Hessen	5
Mecklenburg-Schwerin	4
Saxon Altenburg	3
,, Coburg Gotha	4
,, Meiningen	4
,, Weimar	3
Schwarzburg Sondershausen	1
Wurtemberg	6
	302

Foreign Countries.	
Bulgaria	4
Denmark	4
France	3
Greece	2
Great Britain	3
Holland	2
Italy	2
Norway	1
Austria-Hungary	37
Roumania	1
Russia	83
Sweden	3
Switzerland	9
Servia	8
Turkey	3
North America	1
South America	1
	167

Professions of Fathers.—The following table gives the professions of the fathers of all students matriculated to May, 1902:—

Profession of Father.	Germans.	Foreigners.	Total.	Candidates for office of commercial teacher (included in total).
1. Established in (*a*) Commerce	196	128	324	16
(*b*) Banking	12	4	16	....
(*c*) Hostelry	14	1	15	2
(*d*) Industries	84	23	107	8
2. Higher officials (Managers, etc., in these professions)	23	8	31	4
3. Trade masters	38	7	45	22
4. Agriculturists	27	21	48	10
5. Officials of State or city	41	33	74	11
6. Clergymen or teachers	49	14	63	20
7. Other professions with University education	27	18	45	2
8. Lower officials	35	2	37	11
9. Men of means	38	17	55	10
	584	276	860	(116)

Examinations for diplomas.—At the beginning of every term examinations are held under the chairmanship of a Royal Commission, by a Royal Board of Examiners and a Board selected from University Professors and teachers engaged in the Commercial High School. The constitution of the Board is one commissioner, four representatives of theoretical subjects, three of technical. This Board is empowered to engage the assistance of other teachers in conducting the examinations. The examinations are both written and oral. No examinations are held earlier than the beginning of the fifth half-year.

Applications.

Applications.—Applications for the summer term examinations may be made to 1st March, for the winter term to 1st October, and must be addressed to the Chairman of the Board of Examiners. The applications must be accompanied by :—

1. A biography of the applicant, with date and place of birth, religion, profession of parents, and a detailed description of subjects studied.
2. A list of lectures and exercises attended, certified by the Director of Studies.
3. The maturity certificate or the last school certificate, and commercial references.

The fees for examinations are 60 marks (£3) for Germans and 100 marks (£5) for foreigners.

Obligatory subjects.—The obligatory subjects for examination are :—

1. Higher commercial arithmetic.
2. Book-keeping.
3. German commercial correspondence and office work.
4. National economy and science of finance.
5. Commercial and Bills Law.
6. Elements of economical geography.
7. Elements of history of commerce.

It has been decided to add commercial correspondence in two foreign languages to the obligatory curriculum.

Candidates for positions as teachers of commercial schools, in addition to passing an examination in these subjects, have to undergo a test in teaching and an oral examination in pedagogy.

Form of examination.—The examination consists of a written part done in seclusion and a verbal part. The written work does not exceed four hours for each subject, and includes questions on technical matters in sections 1 to 3 and a subject or subjects selected from sections 4 to 7 in the obligatory list. Candidates failing to pass either branches of written work are not allowed a verbal examination. The verbal examination embraces all obligtory subjects, and does not exceed three and a half hours, as a rule. Several candidates may be examined at the same time.

Deferred examinations.—A candidate failing to get at least a 4th grade certificate is not entitled to a diploma. He may sit again for examination after a half year has expired, but is allowed no further chance. If in the first examination he passed the written test, he is only required at the second examination to answer in the verbal section.

Certificates.—Two kinds of certificate are issued, but only to matriculated students of the Commercial High School, Leipzig :—

1. Diploma to commercial men.
2. Diploma to teachers of commercial schools.

CHAPTER LVIII.

CHAPTER LVIII.

Commercial Education in Hungary,

[G. H. KNIBBS.]

1. *Introductory.*—Special schools for instruction in Commerce are a feature which originated in Hungary—in fact throughout Europe generally—only in the last century.

Before their creation a certain orientation of a commercial character was often given to part of the instruction in the primary schools; for example, pupils were familiarised with the commercial applications of arithmetic, and with a correspondence style in writing; they were accustomed also to draft statements of business matters. Beyond this, special drawing courses were designed, so as to give manual skill and to develope good taste, and this with the direct object of promoting the interests of Hungarian Commerce.

In the Colleges the economic and technical relationships of natural products were specially referred to; geography was developed from the economic, industrial, and commercial points of view, and book-k eeping by double entry was taught as a sort of supplement to arithmetic.

Faculties of law had chairs for commercial science, technology, etc., and at the end of the 18th century Francis Koppi, a Piarist, issued a memoir entitled, "A Project for a Commercial Academy," the object of which was to indicate how the need for commercial education might best be met.

The second "*Ratio Educationis*" (1806) was marked by no special feature, but schools were held on Sundays for obligatory instruction; these afterwards developed into the schools for commercial and industrial apprentices. In Paris the opening, in 1820, of an "*Ecole Spéciale de Commerce*," gave an impulse to the recognition that such schools were a modern need. The Budapest commercial school followed not long afterwards, viz., in 1830; one was opened in Leipzig in 1831; one at Zurich, one at Berlin, and one in Hamburg in 1833, and one in Vienna in 1840.

2. *History.*—This first Hungarian commercial school—that opened in 1830—was started by Emmanuel Bibanco, a Silesian school-master, and with the support of the merchants of Pest, was maintained as a private school. At the end of the first year it became a day-school, instead of a Sunday-school. Starting with only 12 pupils, it had at the end of three years no less than 100.

The Law XVI of 1840 compelled every merchant to keep his books according to certain well-defined rules, and this helped to strengthen the teaching of commerce. Commercial schools were started at Kolozsvár in 1839, at Brassó in 1841, at Nagy-Kanizba in 1843, Késmárk in 1845, Sopron and Arad in 1848; besides these there were many others.

In 1857 the associations of wholesale and retail merchants created the Budapest Academy of Commerce. For the school-year, 1857–8, the programme was as follows :—

Early Commercial Teaching in Hungary.

Subject.	Classes and Hours.			
	I.	II.	III.	Total.
Religion	2	2	......	4
Hungarian	3	3	2	8
German	3	3	2	8
French	4	3	4	11
Italian	......	3	3	6
Political Economy	......	......	3	3
Book-keeping, etc.	2	2	3	7
Arithmetic	4	3	4	11
Geometry and Drawing	3	......	......	3
Elementary Law	2	1	2	5
Natural History	4	4	1	9
Merchandise...	......	......	3	3
Physics	......	4	......	4
Chemistry	......	4	......	4
Technology	......	......	3	3
Commercial Geography, History, Statistics	3	2	3	8
Writing	2	......	......	2
Drawing	3	......	......	3
Totals	35	34	33	102
English (optional)	3	3	3	9

This exhibits at a glance how complete was the provision made for commercial teaching, now about half a century ago, in Hungary.

In the Polytechnicum created in 1857 (in lieu of the industrial school established in 1844). commercial legislation, exchange, accountancy, political arithmetic, the description of articles of commerce, the German commercial correspondence, were all subjects of instruction, with a view to qualifying pupils for the higher offices in connection with the industrial arts, and in commerce.

The

The "Real" Schools developed after 1850 embraced special commercial teaching, and many were transformed into commercial schools. This is true of the Commercial Real School of Nagy-Kanizsa (1857); the School of Commerce of Arad (1860); the Orthodox Secondary School of Commerce, Brassó (1869), and the Commercial School of Debreczen (1870).

In 1868 the military law accorded the right of reduction of military service to one year to all pupils of commercial schools of three classes. In 1872 a complete organisation for the giving of commercial instruction was established.

In the year 1879–80 there were 12 secondary commercial schools, with 35 professors, 68 teachers, and 792 pupils; 32 primary schools of commerce, with 92 professors, and 1,691 pupils.

In 1883 a special academy to prepare for Oriental commerce was created. In 1884 general instruction was separated from the special,—the former being relegated to the primary and secondary schools; while the latter was developed with greater care, and restricted more closely to the forms of commercial correspondence, etc., and to the science of finance. French was ranked among the obligatory subjects.

The scheme will be better understood from the following programmes :—

Programme for Independent Secondary School of Commerce.

Subjects (General).	Classes and Hours per week.				Subjects (Special).	Classes and Hours per week.			
	I.	II.	III.	Total.		I.	II.	III.	Total.
Hungarian (Magyar) ...	3	3	2	8	Commercial Arithmetic ...	5	3	3	11
German	3	3	3	9	Book-keeping, etc.	...	3	3	6
French	3	3	3	9	Commercial Correspondence	4	2	2	8
Commercial Geography ...	2	2	...	4	Merchandise, Technology ...	...	3	3	6
History	2	2	2	6	Exchange, Law, Industrial Law	...	2	2	4
Mathematics	3	2	...	5	National Economy, etc. ...	...	2	3	5
Chemistry and Technology ...	3	...	...	3					
Physics	2	...	...	2					
					Total	9	15	16	40
Total	21	15	10	46	Grand Total ...	30	30	26	86

Optional—English, 3, 3, 3=9 hours; applied chemistry (II) 2 hours; practical work (counting-house (III) 3 hours; writing (I) 2 hours.

Programme for Higher Primary School, with annexed School of Commerce.

Subjects.	Primary School—Classes and Hours per Week.				School of Commerce—Classes and Hours per Week.			
	I.	II.	III.	IV.	I.	II.	III.	Total.
General.								
Religion and Morals	2	2	2	2	1	1	...	10
Hungarian	5	5	3	3	3	3	...	22
German	...	...	3	3	3	3	...	12
French	...	...	...	...	3	3	3	9
Commercial Geography	2	2	2	2	...	...	...	8
Commercial History	...	...	2	3	3	3	...	11
Hungarian Constitution	...	...	...	...	...	2	...	2
Mathematics	5	5	4	3	3	2	...	22
Natural History	3	3	3	...	...	...	...	9
Chemistry and Technology	...	...	...	3	2	...	...	5
Physics	...	...	...	3	2	...	...	5
Drawing	5	5	4	4	3	3	...	24
Writing	1	1	1	...	...	...	...	3
Singing	½	½	½	½		1		3
Gymnastics		1				1		2
Special.								
Arithmetic (Commercial)	...	...	...	...	...	3	3	6
Book-keeping	...	...	...	...	...	2	3	5
Commercial Correspondence	...	...	...	...	3	3	4	10
Merchandise and Technology	...	...	...	...	2	2	2	6
Exchange, Law, and Industrial Law	...	...	...	...	...	...	4	4
Political Economy	...	...	...	...	...	...	4	4
Practical work (Counting-house)	...	...	...	...	...	...	3	3
Totals	...	...	...	...	28	30	28	86
					Commerce only			

It will be seen from the above that Hungary has given considerable attention to practical means of teaching commercial knowledge, and that over twenty years ago she had a highly-developed system.

Under

Under this régime there were in 1889–1890 the following schools of commerce:—

Schools of Commerce, 1889–1890.

State schools	8
Commercial schools with State subsidy	8
Schools of societies " "	5
Private	5
Religious bodies	1
Total—15 independent + 12 annexed to primary schools	27

These had 77 classes, 2,637 pupils, 289 teachers.

3. *Present Organisation.*—On the whole, the above scheme gave general but not complete satisfaction. In 1889 Count Csáky, the then Minister for Public Instruction, invited the Higher Educational Council and the Chambers of Commerce to make proposals for the improvement of the scheme of commercial education.

In 1893 and 1894 congresses were held by the "National Union of Teachers of Commercial Schools," a special journal for "Commercial Education" having been founded a little earlier.

The propositions received by the Minister, discussions thereon in the journal, and by the Union, together with the work of several committees convoked by the successor of Count Csáky (J. Wlassics), led to the issue of order No. 44,001 of 1895.

The new regulation suppressed the title, "Secondary Schools of Commerce," and also that of "Commercial Academy," replacing them by "Higher School of Commerce." The three grades of teaching, lower, middle, and higher, remained, as also the original conditions of admission, excepting, however, the admission-examination. The establishment of annexed schools for commercial instruction in the case of superior primary schools was allowed on the condition that classes V and VI should be independent, instead of having common instruction. Pupils were permitted further to choose as the second obligatory language, English or Italian in place of French, and the maximum hours were to be 34 per week.

Every higher School of Commerce must have, besides the director, at least four professors or teachers. The director is required to devote 10 hours a week to the school, and the professors 18–20 hours. If they give more than this for more than a month they receive special payment; but they are not allowed to give more than 25 hours per week.

The administration and supervision of these schools is carried out by the Ministers of Public Instruction and Commerce conjointly; and the inspection is undertaken by a special "Director-General," not by the inspectors of primary education. The Minister of Public Instruction is, however, the chief authority, and the reports of the delegates or officers of the Minister of Commerce and Justice (Law), are transmitted by him to his colleague.

The Director-General must be chosen from among the teachers of the commercial schools; he is a State officer, with salary, house, and travelling allowances, and the right of pension.

The Director-General is responsible for the supervision of all the higher Schools of Commerce throughout the Kingdom; must see that the instruction conforms to the regulations; that the plan of study is properly co-ordinated; that the text-books used are those approved; he examines the minutes of the professors' conferences; he or his delegate presides at the maturity and class examinations; and he visits at least once a year, to see that the progress of the studies, the school material, library, administration, method, sanitation, etc., are satisfactory. He communicates with the directors and teachers of the schools on all necessary matters, and reports to the Minister.

4. *The Plan of Instruction in Higher Commercial Schools.*—The regulations of 1895 retain in general the plan of instruction under the regulations of 1885. They are as follows:—

(A.) *Obligatory subjects.*—1 Religion; 2 Hungarian language and literature; 3 German; 4 French —for this English or Italian may be substituted; 5 geography ; 6 history; 7 mathematics and political arithmetic; 8 physics; 9 commercial arithmetic; 10 practical work (counting-house); 11 book-keeping; 12 commercial correspondence; 13 theory of commerce; 14 economics; 15 general notions of law; 16 chemistry (mercantile); 17 writing.

(B.) *Optional subjects.*—1 A fourth modern language; 2 stenography; 3 laboratory practice in chemistry; 4 conversations in foreign languages; 5 gymnastics and various games.

The aim of the programme in general instruction is to approach as nearly as possible to the level of the instruction given in the lyceums and "Real" schools. The teaching of foreign languages is a matter of special concern in the commercial schools. The programme for the course in French will sufficiently indicate the scheme of teaching. It is as follows in the next section.

5. *The Teaching of Languages—French (or English or Italian).*

I. *Lower class* (4 hours per week).—Grammar: reading (pronunciation) and general idea of the syntax; rules regarding substantives; conjugation of auxiliary and regular verbs; translation and exercises in grammar. Reading; narratives and descriptions (stories, legends, history, geography, ethnography, natural history, commercial life); poetical extracts; terms grouped according to the several subjects, and especially from a commercial standpoint; French idioms; written compositions (copied, dictated, and translated) during the courses, and also once a fortnight as a home exercise.

II. *Intermediate class* (3 hours per week).—Grammar: irregular verbs; particles; the substantives in syntax, conjugation of verbs; subjunctives; alternation of the tenses; translations, as in the lower class. Reading as in the preceding class; questions in French on the subjects read; conversation. Business documents; reading, dictation, translation, and redaction of business letters; words and terms grouped according to subject and according to etymology; French idioms, synonyms, commercial technical terms; written compositions as in the preceding class; translation into the foreign language, and business letters twice a week.

III.

III. *Higher class* (3 hours per week.)—Grammar : Infinitive and participles ; adverbs, relative and possessive pronouns ; systematic grammar ; grammar as in the preceding classes. Reading ; selections from the classical writers and celebrated economists ; conversations based upon the reading matter. Business correspondence ; business documents, especially commercial letters, read, translated, or imitated after certain models ; written translations, as in the preceding class. The instruction is as far as possible to be given in the language.

6. *Special Instruction.*—Commercial arithmetic may be regarded as one of the important subjects. The scheme is as follows :—

I. *Lower class* (4 hours per week).—Abridged and practical processes ; weights and measures and the coinage of the principal countries of the world ; reduction ; calculations, with weights, measures, and coinage ; calculations of averages ; Italian practice ; partnership rules ; proportional division ; calculation of mixtures ; calculation of percentages in relation to weight ; value and expenditure following commercial custom ; simple and complex calculations of the price of goods ; calculations concerning strength of alcohol ; calculation of interest and discount.

II. *Intermediate class* (3 hours per week).—Calculation of gold and silver standards ; stamping ; gross weight ; purchase of gold from the Bank of Austria-Hungary ; the value of silver, the stamping of coins ; currency and value of precious metals and coins : customs of the exchange ; estimation of national values at the exchanges of Budapest and Vienna ; rule of the Bank of Austria-Hungary in regard to the discount on commercial effects.

III. *Higher class* (4 hours per week).—Exchange ; calculation of estimates at the Budapest, Vienna, and foreign exchanges ; equivalent market prices ; regulation of credits and debits ; bills of exchange—(a) short paper, long paper, (b) drafts and remittances to foreign countries, (c) drafts on intermediary places ; direct and indirect remittances to foreign countries ; estimation of Hungarian and foreign values at foreign exchanges ; exchange of value ; deductions for commissions, drafts, etc. ; calculations of price ; tables of price ; principal operations of the exchanges ; report.

7. *Practical Work in the Counting-house.*

I. *Lower class* (1 hour per week, including writing).—Invoices ; control, stock-books, and balance-sheets ; method and entries ; sales and purchases on commission ; fictitious invoices ; memoranda of bills of exchange, etc.

II. *Intermediate class* (2 hours per week).—Freight and insurance notes for commission business ; cash memoranda ; memoranda of estimates, etc. ; accounts-current, joint, mutual, etc., and with double and variable rates.

III. *Higher class* (2 hours per week).—Repetition of subjects taught in the preceding classes ; matters touching correspondence, arithmetic, and accountancy, etc.

8. *Instruction in Book-keeping and Accountancy.*—This is given in the second and third classes only.

II. *Intermediate class* (3 hours per week).—The functions of the accountant ; legal dispositions touching accountancy ; the commercial code (law XXXVII of 1875) ; law of bankruptcy (law XVII of 1881) ; penalties (dispositions of the law V of 1878) ; conditions concerning the regular keeping of books ; columns to be entered ; commercial matters in relation to the day-book ; debtor and creditor ; formulæ as to entries exacted by law or by usage ; constitutive elements in the position of trader—active, passive, and participating ; inventory, estimations, grouping of claims, etc. ; the two systems—book-keeping by single entry and by double entry ; the French and Italian systems ; scheme of commercial operations.

III. *Higher class* (3 hours per week).—Book-keeping in commercial companies ; entries of a commercial operation ; making out a statement ; entry of syndic and commission business in a commercial house and in a banking house ; entries of matters of the month in a financial institution (in the day-book, etc.), with the correspondence appertaining thereto ; accountancy of an industrial exploitation ; technical expressions in German accountancy.

9. *Commercial Correspondence.*

I. *Lower class* (2 hours per week).—Declaratory and other business documents, such as certificates, receipts, acknowledgements, obligations, quittances, transfers, bonds, procurations, etc. ; applications concerning license, entry in the commercial register ; circulars ; intelligence ; tenders of merchandise ; correspondence relative to credits ; requests for information—orders and letters relating thereto ; documents under the form of letters.

II. *Intermediate class* (2 hours per week).—Correspondence relating to payments ; bills exchanged between creditors and debtors ; letters relating to drafts, remittances, acceptances, domicile, extensions ; special bills, protests, recourse ; letters concerning accounts-current ; drawing out bills, memoranda, etc.

III. *Higher class* (2 hours per week).—Letters concerning commission, transport, and insurance ; correspondence relative to banking matters ; letters in case of bankruptcy ; procurations ; letters of recommendations ; ordinary printed matters (postal orders, payments by post, freight-notes), and their use. All these documents must be drawn up with the required precision, while following, as much as possible, the successive phases of one and the same commercial operation. The German correspondence will be taught conjointly with the Hungarian.

10.

10. *General Conceptions of Commerce, Political Economy, and Law. Lower class* (2 hours per week.)

Definition, importance and categories of commerce; the merchant and his personnel; the firm's name and locale; commercial companies; liquidation; bankruptcy; species of merchandise; systems of weights and measures; stamping; metallic currency, the stamp of coins; exchange; silver, silver paper money, fiduciary silver; credit; interest; bonds, cheques, bills of exchange; various bills of exchange; prescriptions and operations relevant thereto; values, obligations, actions; their issue and liquidation; sale and purchase, offer, negotiation; execution of orders, payment. Intermediate agents, brokers, agents, freight commissioners, commercial representatives, etc.

It is specially enjoined that instruction shall not be limited to mere definitions, but that every endeavour shall be made to bring about a clear understanding of practical work, and the economic significance of the whole of the matters referred to.

Economics II. *Intermediate class* (2 hours per week) *Generalities.*—Requirements and resources; private and national economy. *Production.*—The factors of production: nature, labour, capital; cost of production; sterile production; conditions of productiveness; the State; individual liberty; property; division of labour; enterprise, its national and economical importance; production on a large and small scale; principal branches of production; traffic; the categories and conditions of its development; supply and demand; value and price; free trade; prices and monopolies; tariffs regulated by authority; silver, its importance and value; credit and its consequences; division of revenues; receipts, revenues and rent; ground rent; salary; interest; contractor's profit; public and private consumption; thrift, the spirit of economy; luxury; relation between the production and consumption; crises; insurances.

Special instruction; products of the soil.—Agriculture; systems of culture; agricultural credit. *Industry.*—Limited and extensive industry; trade unions; industrial liberty; means of developing industry: special teaching, syndicates, associations, exhibitions, patents and trade marks; the social question; measures in favour of workmen, on the part of the State; of patrons and workmen. *Commerce.*—Its economic importance; silver, exchange, money; monetary systems of the principal countries of the world; institutions for trade and commerce.

III. *Higher class* (2 hours per week).—Banks, their importance and their kinds; banking business; issue of notes; banks of issue of the principal countries of the world; savings banks; emporiums or depots; insurance; commercial corporations; chambers of commerce; markets and exhibitions; exchanges; the custom-house; external trade; the free-trade and protectionist systems; excise; bonded warehouses; commercial treaties; consuls; compensation of the credits and debts of nations; current exchange; carriage; its importance; roads and waterways; railways; carrying business; the various tariffs of the railways; post, telegraph, and telephone; *the science of finance*; political economy; the budget; State requirements and resources; advance accounts and closed accounts; State receipts; the treasury; the rights of the Crown; monopolies; taxes and their collection; stamps; duties; direct taxation and duties on goods consumed; law of succession; customs laws; the public debt; loans and their liquidation; definition of all these notions; the revenues of the Hungarian State according to the financial laws.

The idea of law. II. *Intermediate class* (3 hours per week).—Civil and political law; family law and law concerning inheritance; fortune; the law of property, of security, of service; legal affairs; contracts concerning trusts, buying and selling, loan, hiring, and labour; conditions of the validity of juridical affairs; juridical representation, procuration; powers; legislation; public powers; central and local administrations; tribunals; law-suit; recapitulation of the conceptions of commerce as taught in the lower classes; principal features of the Hungarian commercial code, in comparison with the main features of foreign legislation; the law concerning bankruptcies, securities, usury, sale, etc.

III. *Higher class* (2 hours per week).—Recapitulation of the matter already taught; laws concerning industry and the administration appertaining thereto; law as to waterways; as to railways; governmental action in regard to the development of commerce and industry; chambers of commerce; consular jurisdiction; legislation concerning patents, the protection of trade marks, itinerant trade, the Sabbath rest, workmen's insurance societies.

11. *Optional Instruction.*—The taking up of the subjects in this category is at the option of the pupils. The schools are under no obligation to provide professors for the teaching of a fourth language; but, although work in the chemical laboratory is optional, it is required that every school shall possess a properly equipped chemical laboratory. A pupil who wishes to study a fourth language course must do so under the same conditions as the obligatory subjects, and should he fail in his examination in this language, he can enter a higher class only after sitting for a new examination. The pupil is allowed to commence the study of the fourth modern language only in the intermediate class (II), but having taken it up he must continue in the higher class, the course involving at least 3 hours per week in the two classes.

The laboratory exercises in chemistry in the intermediate and higher classes are optional; the pupils are not involved in any outlay, and the use of the apparatus is gratuitous.

The number of hours to be devoted to laboratory practice in chemistry, to stenography, and to conversations in foreign language, is fixed by the teaching-staff according to circumstances. They may admit to these exercises and conversations not more than twenty pupils in one group. These courses do not allow of supplementary charge, and the hours devoted to them must fall into line in the arrangement of the weekly time-table of the professor.

Gymnastics and sport may occupy not more than 2 hours per week in the three classes, and there is no supplementary charge therefor.

12. *The Programme.*—The programme of work will be more readily grasped from the tabulated statement hereunder :—

General Programme of the Higher Schools of Commerce.

Subjects.	Hours per week.			
	Lower Division. I.	Middle Division II.	Higher Division III.	Totals.
A.—*Obligatory Subjects.*				
Religion	1	1	1	3
Hungarian Language and Literature	4	3	3	10
German	4	3	3	10
French	4	3	3	10
Geography...	2	2	2	6
History	2	2	2	6
Mathematics and Political Arithmetic	2	2	2	6
Physics	2	...	...	2
Commercial Arithmetic	4	3	4	11
Counting-house Work	1	2	2	5
Book-keeping	...	3	3	6
Commercial Correspondence	2	2	2	6
Notions of Commerce	2	...	...	2
Economical Conceptions	...	2	2	4
Conceptions of Law	...	3	2	5
Chemistry (Merchandise)	...	3	3	6
Caligraphy...	2	...	...	2
Total Obligatory Instruction	32	34	34	100
B.—*Optional.*				
Fourth language	..	3	3	6
Gymnastics	2	2	2	6
Also, Stenography, Practical Chemistry, Conversation (no assigned time.)	...	...	...	...

13. *Internal Régime.*—The internal régime of a higher school of commerce is practically identical with that of the secondary school. These are the principal features. Pupils who have passed an examination—public or private—in all the subjects of the college of the "Real" school, or the superior primary school—Latin being excepted—and who present the certificate of this examination, are admitted into the lower class (I) of the Higher School of Commerce. The special admission—examination—is now a thing of the past.

The pupil who receives a sufficient number of marks in all the subjects of obligatory teaching, —writing excepted—is admitted into the class next above.

If a pupil leaving a Higher School of Commerce wishes to pass into another school, in which a third language other than in the preceding school, is taught, this language will be the object of an examination of admission which the pupil must pass with success.

A pupil coming from a similar foreign school will be admitted in the following class, only if he presents a certificate attesting that he has studied in the said school the subjects that he will require to study in the school in which he desires to gain an entrance; he should, moreover, pass an admission-examination in the Hungarian language, history, and geography, and in the Hungarian constitution.

During the course of a school-year the pupil may change his school only for sufficient reasons. *In no case will more than* 40 *pupils be admitted into a class.* No one is permitted to dispense with an obligatory subject.

The instruction will be given in the Higher School of Commerce with the aid of *text-books approved by the State.* Should a professor regard the approved book with disfavour, he may use lithographed notes, but they must be submitted for the approval of the Minister of Public Instruction.

While the aim of the Higher School of Commerce is to give the pupils that special instruction requisite in practical life, it does not neglect general education.

On the 1st of December and the 1st March, the parents of the pupils receive information as to the progress of their children, and at the end of the school-year (in June), each pupil receives a certificate.

The teaching-staff of each school gives instruction in conformity to the plan of general studies, which may be modified to suit the local needs, subject to the approval of the Director-General. The time-table must be so arranged that no professor shall be required to devote more than three hours to continuous teaching. Once a month the professors meet in conference, in order to discuss the questions of instruction and discipline, and to decide upon the subjects for compositions. The conferences of the 1st of November and end of February decide upon the classification of the pupils.

In the second fortnight of June the pupils of the lower and intermediate classes (I and II) are examined publicly in each obligatory subject. Every pupil is examined, if possible, in each subject; at all events, in every case where the classification is a matter of any doubt.

At the conclusion of this examination the classification is determined according to the following formulæ, viz., "Pass into the higher class;" "Will be admitted to a supplementary examination;" "Repeat the work of the class." Pupils who have failed in only one or two subjects, are admitted, after two months, to the supplementary examination; if, however, they fail in more than two of the obligatory subjects, the pupil must unequivocally repeat the work in the class.

The pupils leaving the higher class undergo, in lieu of a class examination, the "Maturity" examination.

14. *Private Pupils and their Examination.*—The decree or regulations of 1895 contain the first provisions in regard to what are called private examinations.

When the regulation of 1884 conferred upon the pupils of the schools of commerce the one year's military service, and gave them access to certain administrative careers, the number who studied commercial subjects at home without attending the school was observed to increase with great rapidity. The Minister exhibited some severity at the admission to these examinations, nevertheless the abuses did not diminish, and private examinations became, for certain schools, an illicit source of income. The Minister endeavoured by the regulations of 1890 and 1894, to correct these abuses by subjecting these examinations to stringent regulations. The matter, however, was definitely settled only in the organisation of 1895.

The existing regulation decreed that the pupils who study privately, or in other than a public school, must formally apply for admission to the class examination at such public school of commerce as may be indicated by the Director-General. The application must indicate the place and object of the studies made during the past school year, and the date of the examination is fixed by the Director-General.

Pupils who have followed the courses or passed the examination of class IV of a superior primary or of a secondary school, are admitted to the examination of the lower class (I), and those who have the certificate of the lower class, are admitted to the examination of the intermediate class (II).

The identity of the private pupil must always be verified with the assistance of documents. The examinations of the lower and intermediate classes take place within a year of one another, and the pupil is admitted to the "*Maturity*" examination only after a lapse of a year from the examination of the intermediate class (II). Any delay may be reduced only on the motion of the teaching staff and Director-General, and with the sanction of the Minister of Public Instruction; nevertheless in all cases the pupil must undergo a special examination for each class, unless the Minister grants a special permission for a summary examination.

The private examination is presided over by the Director-General or his representative, and consists of a written and an oral examination.

15. *The "Maturity" Examination, and the Privileges Enjoyed on Passing it.*—The following is the procedure for the "Maturity" examination.

This examination closes the studies of the Higher School of Commerce. As a rule, the pupil is examined at the school at which he has followed the courses of the higher class (III), or in which he has passed the examination of the intermediate class (II).

The function of the *Maturity Examination* is to ascertain whether or not the pupil has acquired that general education and special knowledge which his future career and social position demand.

For this examination, an examination commission is constituted, composed as follows:—The Director-General or a Commissary of the Minister of Public Instruction (President); the Commissary of the Minister of Commerce (Vice-president); the director and the professors of the higher class, members.

The ordinary "Maturity" examinations take place at the end of the scholastic year; the supplementary examinations, in September and in December, on days fixed by the Commissaries of the abovementioned Ministers.

The examination consists of two parts, (a) a written, and (b) an oral examination.

(a) The *written examination* refers to the Hungarian, German and French languages (or English or Italian), to commercial correspondence, political arithmetic and accountancy. A special day is fixed for each subject; the subjects are indicated by the Director-General; 5 hours are allowed for each paper; the examination is rigorously supervised.

The special professors review the work and award the marks, and in conference agree upon the classification, but do not decide with regard to the admission to the oral examination. All the papers are submitted to the representatives of the two Ministers above referred to.

A full sitting of the *Examination Commission* decides upon the admission to the oral examination, and admits the pupils whose papers have been found at least "sufficient" (elégésgés). The pupil who has "insufficient" (elégtelen) for a subject, could still be admitted to the oral examination, but must be specially examined on the subject in question. Those who are found "insufficient" in Hungarian and in not more than two other subjects, may be admitted in September to a second written examination, and, in the event of success, to an oral examination on the same subjects; for the other subjects the oral examination is passed with the others. If the pupil has received the award "insufficient" for three or more subjects, he is absolutely obliged to go through the class again. Those who fail at the written supplementary examination, may be admitted to a new examination, but only by the authority of the Minister of Public Instruction.

(b) The subjects of the *oral examination* are:—History of Hungarian literature, theory of business affairs, chemistry, merchandise, general ideas as to law, economics, history (of Hungary and of commerce), commercial geography. The Commission may decide whether such pupils shall undergo the oral examination on other subjects or not.

The oral examination is public.—Not more than 12 pupils are examined in one day. The President calls up the pupils, and puts the questions drawn up by the special professors; and the Commissary of the Minister of Commerce has an equal right to question the pupils. Each question is entered upon the minutes of the examination.

After the examination the Commission re-assembles in conference and decides the classification of each pupil. In the "Certificate of Maturity" is inscribed remarks on the moral conduct of the candidate, on the character of his papers, on the subjects of the higher class, and on the optional courses. The pupil who fails in one or two subjects at an oral examination is admitted, in September, to a supplementary examination; if he fails in three subjects, he will be admitted to the supplementary examination only at the end of a year. Those who fail in more than three subjects are compelled to go through the higher-class (III) course again. Similarly for those who fail at the supplementary examination. A pupil who fails at two complete examinations, is not further admitted to the "Maturity Examination" except by special authorisation of the Minister. After the supplementary examination has been successfully undergone, a fresh "Maturity Certificate" is awarded.

Should the President of the Commission have any observations to make as regards the procedure followed, he may refuse to sign the certificate and invoke the decision of the Minister. Should it be the vice-president who has observations to offer, he presents his report to the Minister of Commerce. The fee

fee for the examination must not exceed 20 crowns (about 16s. 4d.) The supplementary examination is always gratuitous. [The fees are divided between the Director and the examining professors according to the subjects taught.] The minutes of the "Maturity Examination" are forwarded to the Minister of Public Instruction, to which are added specimens of compositions: one "excellent" (jeles), one "good" (jó), and one "sufficient" (elégséges) for each subject.

The maturity certificates of foreign "Higher Schools of Commerce" are recognised by the Hungarian Minister of Public Instruction only if the bearer submits himself to a complementary examination in subjects specially concerning Hungary.

The pupils possessing the "Maturity Certificate" of the Higher Schools of Commerce have access not only to a commercial or financial career properly speaking, but also to the lower administrative offices; they are qualified for entrance into the Academy of Oriental Commerce; to the courses for the railway service as clerks, etc.; to the agronomic institutes; to the Normal Commercial School; and as auditors to the science faculties of the University. Finally, they are entitled to the one-year's service, similarly to the pupils in France who possess the diploma of a French higher commercial school.

16. *Qualifications of the Professorial Staff.*—According to the regulations of 1895 the professors of the higher commercial schools must all possess the license of a secondary teacher for general subjects. For the teaching of civics and economics he must possess the diploma of doctor of law; if he intends to teach geography, chemistry, a knowledge of merchandise, commercial arithmetic and political arithmetic, book-keeping, commercial correspondence, he must undergo the general examination prescribed for the professors of secondary schools, and also pass a special examination in the subjects which he intends to teach.

In order to pass the general examination, the candidate must verify that he has followed, as inscribed student or as auditor, four semesters of the University or of the Polytechnicum.

The special examination is passed before the Examining Commission of Professors of Commercial Schools, created from among the Examining Commission of Professors of secondary schools, by the Minister of Public Instruction; the Minister of Commerce is also associated as a member.

From the point of view of the license of qualification of the professors, the subjects of special instruction are divided into three groups, viz.:—

Group I.—Book-keeping, theory of commerce, commercial correspondence. The special examination is preceded by a general examination for Hungarian and German.

Group II.—Commercial and political arithmetic; here the general examination includes also mathematics and physics.

Group III.—Geography, chemistry, knowledge of merchandise; the general examination refers to geography and chemistry.

After passing the general examination, the candidates must, during four semesters, attend courses in the special subjects of their group, either in one of the two universities, or the special courses which have been created for the purpose in 1898, to which reference will be made later.

Professors who already possess the license for secondary teaching may be admitted to the special examination with the authorisation of the Minister of Public Instruction.

17. *Statistical Details concerning the Higher Commercial Schools.*—In 1897–98 the number of these schools was 37. Fifteen were wholly maintained by the State, 6 were communal schools subsidised by the State, 5 were maintained wholly by the communes, 2 by religious bodies, 4 by societies or corporations, and 5 by private individuals.

Twelve of the State schools and 4 of the communal schools were connected with the higher primary schools; the Higher Commercial School of the Orthodox Roumanians (Brassó) is attached to a lyceum, the other 20 schools are independent.

In two of the State schools, viz., Brassó and Késmárk, in a communal school (Arad), in a school maintained by a society at Kolozsvár, and in two private schools, viz., The Röser school at Budapest and the Propper school at Nagyvárad, there are residential quarters for the pupils.

These schools possess a total of 434 rooms, etc., of which 175 were class rooms, 73 were depôts for apparatus and material, and 186 were otherwise occupied.

In 1897–8 the number of pupils at the beginning of the school-year was 5,637, and at the end of the school-year 5,011; 1,595 presented themselves for the "Maturity Examination," out of which 1,039 passed with success; 195 candidates, viz., commercial and bank clerks, functionaries of the post and telegraph, and other auditors, passed the private examination.

The students of Hungarian numbered 5,011, viz., 3,888 Hungarians, 832 Germans, 81 Slavonians, 64 Roumanians, 67 Servians, 31 Croatians, 2 Ruthenians, and 46 belonging to other nationalities.

As regards religion, there are 2,450 Jews, 1,704 Catholics, 307 Protestants, 300 Lutherans, 200 Orthodox, 46 Greek Catholics, and 4 Unitarians.

The number of professors was 403, 164 of whom had licenses for secondary schools, 76 for commercial schools, 93 for higher primary schools, and 9 teachers of higher primary instruction, and 61 teachers with special diplomas. Analysed in another manner, there were 231 titular and 25 associate professors, and 147 lecturers. It may be noticed that among the 403 professors there were but 9 who did not know the Hungarian language.

The salaries of the professors and teachers are increased about 10 per cent. quinquennially, and after 30 years' service they are entitled to a pension.

The cost of maintenance of the 37 Higher Schools of Commerce was contributed to by the State to the extent of about one-third, the remaining two-thirds being derived from school fees.

The school fees vary from 32 to 80 crowns, say 27s. to 67s., per school-year in the public schools; from 32 to 200 crowns, say 27s. to 177s., in the communal and confessional schools; and from 160 to 300 crowns, say 133s. to 250s., in the schools maintained by corporations or private individuals.

18. *Higher Commercial Studies.*—In order that the teachers in the higher commercial schools should be properly trained and that a higher grade of commercial education should also be available, the necessity was recognised by the Hungarian authorities, of establishing a course of higher commercial study to which reference may now be made.

These

These studies are made in what may be called "Superior Commercial Institutes," and are additional to the 37 Higher Commercial Schools previously referred to. A complete system of higher commercial education demands the following further provisions, viz.:—

(1) A Special Course of commerce for the licentiates of secondary schools.
(2) An Academy for Oriental commerce.
(3) A Normal School for commercial teaching.

A special commercial course was inaugurated in 1883 at the Commercial Academy at Budapest, so that students who had passed the " Maturity Examination " of a secondary school, or who have regularly gone through the course of a special agronomical or industrial school (the certificate of which entitles to the benefit of one-year's military service), may acquire, in a period of a year, the requisite knowledge for a commercial career. After this course they are regarded as qualified to enter upon a career on their own account as merchants, or to fill positions in commercial houses, as well as in financial, industrial, or shipping businesses.

The course is arranged under a definite and complete programme. The student who has assiduously gone through the prescribed course and duties, receives, on passing the end examination, a certificate or diploma.

The commercial instruction is given daily, from 8 to 12 or to 1 o'clock, and involves 28 hours per week. The course is under the direction of Director and professors of the Commercial Academy, but is not of a public character. In 1897–98 58 pupils entered for it; of the 41 who completed the course 27 passed the examination, 11 intended to undergo a supplementary examination, and 3 have been obliged to repeat the course.

For many years past the Hungarian Government has been anxious to bring about active economic relations with Eastern countries. This aim led, in 1883, to the creation of a course of Oriental languages at the Commercial Academy of Budapest. In 1885, the course was *officially constituted*, and in 1891, more fully organised under the title of *the course of Oriental Commerce.* From the commencement the aim of the course was to give future merchants that opportunity to learn the Eastern languages, and to acquire such commercial, ethnographical, and other requisite ideas of Eastern peoples, as to be able to take a normal place among the founders of commercial intercourse between Hungary and the East. The special course involved two years. The instruction is given in the Commercial Academy of Budapest.

There are two classes of pupils, viz., " regular pupils," who register for and attend the regular courses, and who undergo the examinations, and irregular students, or " free auditors," who attend any parts of the course, with a view to acquiring special knowledge. Candidates who have passed the " Maturity Examination " of any Higher Commercial School, or a secondary school, are admitted; also, clerks in commercial houses, who prove by examination that, on the subjects of special commercial teaching, they have the same knowledge as the pupils who have passed the " Maturity examination " at a Higher School of Commerce. To be admitted to the higher class of the Academy, it is necessary to pass an examination on the subjects of instruction of the first-class. Clerks actually engaged in commerce, are admitted as " free auditors," provided only that they have sufficient education to be able to follow the course.

19. *The Programme of Studies of the Oriental Commercial Course.*—The programme includes the following subjects :—

(a) *Roumanian, Servian, Bulgarian, Turkish, Arabic, modern Greek and Italian.*—Six hours per week are devoted to the teaching of each language in every class, with the exception of Italian, which is 4 hours per week. Each pupil must take at least two of these languages, and Bulgarian and Servian are counted as one language. The ordinary Arabic of Egypt is taught for 3 hours per week in the second class, only to the pupils who already possess a knowledge of Turkish.

(b) *The ethnography and geography of the East*, to which are devoted 4 hours per week in the two classes, treat on all the States of the Balkan Peninsula and of Asiatic Turkey.

(c) *Commerce, and Custom-house procedure, elementary judicial ideas, and an explanation of the nature of the Consular service* occupy 2 hours per week in both classes. The curriculum is as follows :— Definition of customs; laws, their fiscal and economical character; procedure as regards entry and declaration; customs' politics; recognition of law; the customs tariffs and their general character; principles of the customs laws; commercial treaties; their principal features and the annexed tariffs; significance of " the most favoured nation;" features of navigation and border trade; conventions and decisions concerning customs laws; the tariff customs of Austro-Hungary in the past and at present; suppression of the free ports of Fiume and Trieste: the tariff arrangements of Bosnia and Herzegovinia; commercial treaties of the Austro-Hungarian Monarchy, especially with the Balkan States; commercial codes and customs tariffs of Roumania, Servia, Bulgaria, the Ottoman Empire, Greece and Egypt. *Statistics of external commerce.*—Judiciary situation of the Balkan countries; the consulates, their political and commercial functions; rights and functions of Austro-Hungarian consuls.

(d) *Transports.*—Means of transport; laws and regulations concerning the post and telegraph in Hungary; the judicial situation of the postal administration; details regarding the postal and telegraphic services of Hungary and in the Balkan countries; postal geography; interior navigation, its laws and geography; the navigation of the Danube; businesses connected with navigation in Hungary and in the East; navigation tariffs; maritime navigation and its laws: Hungarian, Austrian, French, Italian and English; geography of navigation in the Mediterranean, the Adriatic, the Ægean Sea, the Black Sea, the Suez Canal, and the Persian Gulf; the mercantile navy; the business of maritime navigation (" Lloyd," " Adria," and other houses of Fiume); the railways of Hungary and the East; international conventions in respect of railway trade; regulation of the railways of the East; the principal railways of Hungary and the East: the tariff systems; system of rebates and reductions of tariff; reclamations; routes of caravans and other means of transport in the East.

(e) *French*, 3 hours per week in the two classes.

(f) *Special Commercial Instruction* (3 hours per week in the two classes).—Commercial arithmetic, book-keeping and commercial correspondence, as in the Higher Commercial Schools.

(g)

(g) *A course of Oriental Languages* (inaugurated in 1897–8 for factory clerks, bank clerks, and others, who require a knowledge of an Oriental language).—This course lasts from October until the end of May, the hours being from 6 to 8 hours in the evening; it was attended in 1897–8 by 27 commercial clerks.

(h) *Excursions in the East.*—In order to extend their knowledge, the pupils of the school take each year, with their professors, an excursion to the East, for the purpose of visiting the principal markets there.

20. *The Examinations of the Oriental Commercial School.*—At the end of the second year the pupils pass an examination on the whole range of subjects of the school-programme. The members of the supervising council assist at these examinations.

Pupils who pass with honors are qualified for employment in the Oriental agencies of the *Royal Hungarian Commercial Museum*, or receive travelling scholarships. If there are not sufficient vacancies at the Commercial Museum, the leaving pupils may compete for two prizes of a 100 "gold francs," founded for this purpose by the Minister of Commerce.

The Academy has at its head a supervising Council, consisting of two delegates of the Minister of Commerce, two delegates of the Minister of Public Instruction, and of a representative of the Commercial Academy of Budapest. The Director of the school is member *ex-officio* and committee reporter (secretary). The president is nominated by common agreement between the Ministers of Public Instruction and Commerce.

The school is under the control of the Minister of Public Instruction, but in questions of principle the advice of the Minister of Commerce is sought.

Regular pupils pay a school-fee of 80 crowns (about £3 7s.) per year; which is not exacted of poor pupils whose conduct is satisfactory. The "free auditors" pay for each course that they attend, an annual fee of 2 crowns (about 1s. 8d.) per hour of the weekly programme; and there are no exemptions whatever.

Poor pupils of the Academy, whose conduct is satisfactory, receive scholarships arising from considerable endowments made by the Minister of Commerce, by commercial corporations, by chambers of commerce, and by private individuals.

The school has had during the school-year 1897–8, 30 pupils, 20 being regular students in the first, and eight in the second class; and two were irregular students. A number of pupils issuing from this school are employed in the agencies of the Royal Hungarian Commercial Museum at Constantinople, Salonica, Philippolis, Roustchouk, Bucharest, Sofia; while some have received scholarships, in order to stay at Odessa and Smyrna.

In 1897–8 the number of professors was 11, of which there were four regular; the others were paid according to the number of hours of instruction given. All are paid by the State.

In 1898–9 the school received, after eight years of existence, a more extended organisation. French and German have now become obligatory subjects. An Encyclopædia of Law, the Law of Nations, and Administrative Law are added to the programme, an hour per week being given to each subject. A course on Legislation respecting commerce and credit, as well as on political economy and finance, are also added; commercial arithmetic and book-keeping are much more highly developed.

The school has now received the title of "Academy," and its qualified pupils may be employed not only in the agencies of the Royal Hungarian Commercial Museum, but also in the commercial and administrative functions of the Consulates.

This institution is comparable in character to other schools for High Commercial Studies, such as those at Vienna, Berlin, and Naples.

21. *The Normal School of Commerce.*—In the opinion of the Hungarian authorities the University should train and educate the professors of the commercial schools, as it does the professors of other secondary schools. It is felt also that the committee for the qualifying examinations of professors of secondary schools should award the qualifying diploma. As, however, the special commercial teaching does not, as things stand, easily adapt itself to the existing programme of University studies, an institution for giving the commercial teachers the necessary practical instruction, was early recognised as a necessity. The regulation of 1895 involved a definite solution of the difficulty, and the then Minister of Public Instruction (M. Wlassics), with the concurrence of the Minister of Commerce, established at the beginning of the scholastic year 1898–99, a normal school for the education of teachers in commercial science. This is attached to the University of Budapest and to the Polytechnicum, and having a practising school in the Commercial Academy of Budapest, it is almost ideally constituted for those who wish to prepare themselves for teaching in the commercial schools. It provides them with the means of deepening their knowledge in subjects taught neither at the University nor at the Polytechnicum, and to acquire a pædagogical skill.

The following sufficiently indicates the régime:—

(a) The candidates attend the courses in the University or Polytechnicum as advised by the Director of the school.

(b) The commercial sciences proper are taught in the normal school.

(c) The candidates must attend the exercises of the seminary.

(d) The candidates assist at the courses in the Commercial Academy and hold conferences for the discussion of professional subjects.

(e) They visit banks, counting-houses, etc , factories, and dockyards.

The University students and the students of the Polytechnicum, who are qualifying for teaching in the commercial schools, are duly registered as students of the school and admitted. The courses and practice are free.

Initially the courses and practice take place in the lecture halls, etc., of the University, the Polytechnicum, and the Commercial Academy.

The special courses refer to the commercial subjects included in the regulation of 1895; but, besides these, there are courses on the special features and methods of commercial teaching, on the history and the present status of this teaching, and on political economy.

During

During the school-year 1898–99 the courses and the classes were as follows:—

Subjects.	Classes and Hours per Week. I.	II.
Political arithmetic ...	2	2
Calculation of probabilities ...	1	......
Commercial arithmetic ...	2	2
Book-keeping and accountancy ...	2	2
Hungarian and German commercial correspondence and ideas concerning commerce ...	2	2
Commercial geography ...	2	......
Mechanics, technology ...	......	2
Political economy ...	2	......
Hungarian commercial style ...	1	......
Methodology of commercial teaching ...	1	......
Total ...	15	10

Finally German and French are studied.

The scholastic year is identical with that of the University. The teaching is committed to the University professors, and to those of the Polytechnicum, and of the Commercial Academy of Budapest. The school is under the direction of a professor of the University.

The school had, in 1899, 49 registered candidates, of which 9 were regular students, 39 were "auditors," of the faculty of philosophy, and 1 was a law student. Of these 49, 38 had attended a school of commerce, 9 had come from lyceums, and 2 had the diploma of qualification for primary teaching. The greater number of them attended courses in book-keeping, correspondence, commercial, and political arithmetic.

It will be seen that the system of preparation is excellent, and the higher education of the teacher of the commercial school is not neglected, the University having its normal influence.

22. *Other forms of Commercial Education.*—An account of Hungarian commercial education would not be complete without some reference to its humbler forms, such as that provided for what are known as apprentices to commerce, and commercial education for women. In fact, the thoroughness of the whole scheme is only fully realised when it is seen that the needs of all classes are systematically met.

The origin of such forms of instruction is of interest and importance, consequently some historical references will be necessary.

23. *Schools for Commercial Apprentices.*—The first commercial school, established in 1830, which has been before referred to, was in the main, merely a Sunday-school for commercial apprentices. It is this nucleus that has developed, within a half-century, to an important element in the Hungarian system of commercial teaching. Along with the higher schools the lower ones continued to spread, and to become consolidated: and all modifications in the organisation of the secondary or higher schools of commerce most naturally directed attention to the primary teaching also.

The legal foundation on which these schools were established was the law of 1868 *concerning primary teaching*, which declared that no apprentice could engage in commerce unless he was 12 years of age, and had passed through the six classes of the primary school. The apprentice who is employed commercially at the age of 12 years must, for 3 years more, attend some continuation school, or the apprentice-school established for this purpose. The provisions of the law as to the schools for improvement, determine in consequence the minimum function of the apprentice-school. Consequently, the regulations which modified the régime of commercial secondary teaching in 1872, in 1884, and in 1885, have had their influence on the scheme for the instruction of apprentices to commerce.

Next to the law of 1868 on primary teaching, the law of 1884 on industries, is that which has exercised the greatest effect on the schools, for it regulated the régime of all the apprentice-schools, and gave a definitive form to the schools for commercial apprentices. This law, having necessitated the modification of the earlier provision, gave rise to the regulations of 1893, and later to those of 1897, at present in force.

24. *Actual Organisation of the Schools for Commercial Apprentices.*—Every commune in which there are at least 50 commercial apprentices within the age of obligatory teaching, is obliged to establish a school on their account. If the number of apprentices be less than 50, the commune must organise an *industrial apprentice-school*, so that the commercial apprentices may receive the instruction requisite for their needs by means of a special course.

The maintenance of the apprentice schools is incumbent on the commune which has at its disposal the following resources:—

(1) The fees and penalties which must be specially appropriated for this object;
(2) The other revenues of the commune;
(3) Should these be insufficient, the Ministers of the Interior and Finance authorise the collection of two additional centimes;
(4) Subsidies may be granted by the Minister of Public Instruction.

The *apprentice-school* demands three years' nominal attendance; really ten months each year (from September to June). Apprentices who are already 12 years of age, but have not the school certificate, and cannot therefore undergo the admission examination, must initially attend *the preparatory class.*

At least seven hours per week are devoted to the teaching; it is given each evening excepting holidays and Sundays. An additional hour on Sunday is devoted to religious instruction.

The

The instruction is given in Hungarian; but the Minister of Public Instruction may grant the permission that in particular schools the teaching may be in any other language. In such a case, however, it is necessary to devote at least two hours per week to speaking and writing Hungarian.

From the time that the apprentice enters his employment, his master must see that he attends an apprentice-school; or, failing that, an improvement or continuation course in the primary school. His attendance should continue during the whole of his apprenticeship; but if he finishes the three courses with success before the end thereof, the Direction may exempt him.

At the end of the third year, the apprentice receives his *certificate*.

The buildings and the material of the public schools, and particularly those of the higher primary schools, may be utilised for this purpose as far as possible. Each apprentice-school is required to be furnished with (a) a collection for the teaching of technology and the knowledge of merchandise; (b) a school library. The books used must be approved by the Minister of Public Instruction.

Professors or teachers having the diploma of qualification for teaching in the higher commercial schools or in the higher primary schools have precedence in the selection of the teaching-staff. The preparatory class as well as the instruction in reading, redaction, and writing, may be committed to the ordinary primary schoolmaster. Masters whose aptitude as teachers of apprentice-schools is officially and practically established, are furnished with a special license. Some of the professors are engaged for a period of three years.

At the head of each apprentice-school is a Director. He is the principal of the teaching-staff; he directs the intellectual and material affairs of the school, and undertakes part of the teaching himself.

25. *Programme of Studies in the Apprentice-Schools.*—The obligatory teaching is as follows:—(1) Reading and redaction, object-lessons; (2) Geography; (3) Commercial arithmetic and counting-house work; (4) Book-keeping and accountancy; (5) Bills of exchange, correspondence; (6) Writing (caligraphy).

Some notion of the nature of the teaching will be had from the following outline:—

(1) *Reading and redaction, object-lessons.*—Exercise in reading, analysing the meaning, accentuation, etc.; oral résumé; application of grammatical rules, etc.; the awakening of the sentiments and of the patriotism of the pupils; useful knowledge in the domains of commerce, history, and natural science; civic instruction; the reading of Hungarian poetry; exercises in orthography; redaction of business letters and documents; caligraphy.

(2) *Geography.*—The type of geographical knowledge necessary in the every-day life of a merchant; description of natural phænomena from the point of view of raw material of industry, and the shipping or transport business.

(3) *Commercial arithmetic and the work of the counting-house.*—The detail of the operations in a counting-house and in connection with trade.

(4) *Book-keeping, etc.*—The keeping of books in a retail business.

(5) *Bills of exchange and commercial correspondence.*—Explanation of the nature of bills of exchange; the details of complete operations with bills of exchange; redaction of simple business letters in the usual forms; contracts; petitions addressed to the authorities.

(6) *Caligraphy.*—The pupils are required to learn to write elegantly.

The following indicates the time devoted to the various subjects:—

Programme in the Independent School for Commercial Apprentices.

Subjects.	Classses.				
	Prep.	I.	II.	III.	Total.
Reading, Redaction, Object-lessons	4	2	2	1	9
Geography	...	1	1	...	2
Commercial Arithmetic and Counting-house work ..	2	2	2	2	8
Book-keeping and Accountancy	...	1	1	2	4
Bills of Exchange, Correspondence, etc.	...	...	...	2	2
Caligraphy	1	1	1	...	3
Total	7	7	7	7	28

If the number of commercial apprentices is not sufficient to establish a special school, this teaching is given them in the industrial apprentice-school, the general teaching as usual, and the special teaching in particular courses.

There are, also, for the benefit of commercial clerks and journeymen, improvement courses, not of an obligatory character.

26. *Administration of the Schools for Commercial Apprentices.*—The administration devolves (a) upon the committees of these schools; (b) upon the industrial authorities; (c) upon the Directors-General.

(a) The committee of the apprentice-schools has the supervision of the studies and the administration of the intellectual and material affairs. It elects its president, its vice-president, its curator, and its secretary from among the personnel of the public teaching-staff or persons interested in public instruction, or from among the *educated* traders of the locality. If the local authority maintains a school for both industrial and commercial apprentices, a committee is formed, including both merchants and the chiefs of industrial establishments.

The committee meets once every two months (or oftener), and the minutes of these meetings are submitted to the inspector of primary teaching. If the inspector has any remarks to make, he communicates them to the committee, which has recourse, through the medium of the Director-General, to the Minister of Public Instruction.

(b)

(b) The "Authority of first instance," charged with executing the law relating to industry, sees that the apprentices attend the school with the requisite regularity. In cases of negligence, it inflicts penalties, and it supports the Director of the school in the maintenance of discipline.

According to the law relating to industry, this function is incumbent upon : (i) in the communes, the chief of the arrondissement; (ii) in the towns, the mayoral council; (iii) in the municipally autonomous towns, the chief of police; (iv) in Budapest (the capital), the chiefs of the arrondissement.

This authority submits, to the Ministers of Commerce and of Public Instruction, all proposed modifications having regard to the duration of studies and the hours of teaching.

(c) The Inspector of primary teaching and the Directors-general. The superintendence of apprentice-schools is a duty discharged by the inspectors of primary teaching; the chief direction is exercised by common agreement among the Directors-general nominated by the Minister of Public Instruction and the Minister for Commerce.

The Inspector of primary teaching is the vehicle of communication between the Minister of Public Instruction and the apprentice-schools; he conveys the ministerial decrees and sees that they are carried out; he submits reports relating to them, if they come within the necessity of his sphere of action, to the Director-general; he visits, at least once a year, the schools of his district, superintends the works of the masters, directors, and committees, and when it is necessary he stimulates their zeal.

The duties of the Directors-general, charged with the superintendence of the commercial apprentice-schools, are defined in a special instruction, of which the following are the principal points :—

The chief direction of the industrial teaching, which includes that of the commercial apprentice-school, the commercial course for women, and the improvement course for journeymen, is exercised by the Ministers of Commerce and of Public Instruction, each one nominating a Director-general of industrial teaching. Each of these Directors is responsible to his own Minister.

The Director-general nominated by the Minister of Commerce exercises the chief direction of the special schools, the practising schools, and the industrial museums; the other Director of the commercial and industrial apprentice-schools, of the improvement course for industrial workmen and commercial clerks, the practising schools attached to the higher primary schools, and the normal schools for masters and mistresses, of the commercial course for women, and, finally, of the preparatory courses of the masters of apprentice-schools.

The two Directors-general have the "dispositive right"[1] as regards the schools entrusted to their direction. Each has, moreover, the right of inspection as regards the schools presided over by the other Director-general. The one nominated by the Minister of Commerce supervises the practical and special teaching in the schools of which the Minister of Public Instruction is the head. The Director-general of this last-mentioned Minister exercises the same functions in regard to the general and theoretical teaching in the schools directed by the Minister of Commerce. This inspection is limited to the control and does not include the "dispositive right." The two Directors mutually communicate their observations and submit their propositions to their respective Ministers.

Besides the apprentice-schools maintained by the State, the communes, and the religious bodies, the Minister may authorise the establishment of apprentice-schools to be maintained by societies or by private individuals. The ministerial regulation is obligatory for all the schools, and no modification can be made without the authority of the Minister.

27. *Statistical Details of the Commercial and Industrial Apprentice-Schools.*—The commercial apprentice-schools being in part attached to similar schools for industry, these latter are included.

In the school-year of 1896–97, there were in Hungary 369 industrial apprentice-schools, with 1,785 classes, 75,144 apprentices, and 2,167 instructors. The independent schools for commercial apprentices numbered 86, with 6,076 pupils, and 362 instructors. There were 2,281 commercial apprentices who attended industrial apprentice-schools.

On all hands the progress of these schools is regarded as satisfactory.

28. *The Commercial Courses for Women—History.*—The idea of training women for commercial and industrial careers originated prior to 1880, a congress of industrial corporations having discussed the question in 1879 and issued a resolution advocating professional instruction for women.

Some attempts to give effect to this were made here and there, more especially by private individuals, and some commercial establishments employed women who had received commercial instruction.

The first properly organised commercial course for women was not inaugurated, however, till 1888, when, with the assistance of the professors of the higher primary school of Budapest, that city developed a course for young girls in the fifth arrondissement.[2]

At first the course was for six months only; but the increasing attendance having demonstrated its value, it was extended to eight months. The success of this experiment induced Count Csáky (then Minister of Public Instruction) to put in force, in accord with the Minister of Commerce, a regulation for commercial courses for women. (15th March, 1891, No. 59,258.)

This regulation has the aim of extending the number of honorable careers open to women. Women having commercial knowledge had previously to this been in great request, owing to their modest demands, their reputation for politeness toward clients, and for honesty. These qualities, valuable in all establishments, were particularly so in those who could not bear the expense of the more severely trained male pupils, or in warehouses specially patronised by ladies.

The courses in question assure the recruiting of female assistants, who are deemed in Hungary to be valuable collaboratrices in commerce. They are also valued in Hungary for their service to women whose position compels them to engage in business, and who may, one day, even be called upon to wholly manage a business concern. Again, there are many women occupied in industry, and there are certain industrial establishments which exact a spirit of enterprise, careful calculation, accurate accountancy, in short, special business knowledge, which are carried on almost entirely by women. The higher schools for young girls tend to develope a practical spirit, and these commercial courses are regarded as a great boon to families of fallen fortunes, and to all who, perforce, are compelled to enter upon a commercial career, and so gain a modest but assured livelihood.

The regulation of 1891, slightly modified by a decree of 1893, is still in force.

29.

[1] The "dispositive right" is a juridical term relating to the purview of the administration.

[2] An "arrondissement" is similar to our "ward."

29. *Curriculum.*—The programme of studies is as hereunder. The commercial course for women if designed specially to prepare women for the occupations of retail trade. The teaching is similar to that of the primary schools of commerce, but aims only at limited requirements. The subjects of teaching are as follows:—

Subjects.	Hours per week. I Class.	Hours per week. II Class.
Commercial Arithmetic	4	2
Book-keeping	2	4
Bills of Exchange, Ideas of Commerce	2	2
Counting-house Work, Correspondence in Hungarian	2	2
" " " in German	2	2
Description of Merchandise, Commercial Geography	2	2
Caligraphy	1	1
Totals	15	15

The following are optional subjects:—German and Hungarian stenography, and, in some courses, type-writing. This feature is extending. In some cases the hours devoted to Hungarian correspondence, commercial arithmetic, and to the description of merchandise, are increased. The course commences in September, and lasts from nine to ten months.

In order that the teaching may be really useful, a plan of studies is drawn up, with a view to ensuring the proper graduation of the subjects and the necessary regularity of sequence. The course is also divided into two periods, the first being a preparation for the second. The professors draw up for each period a special programme, which is submitted for the approval of the Inspector of primary teaching. In these courses the text-books approved by the commercial apprentice-schools are employed.

30. *Admission; Professors; Material.*—Young girls who have passed with success the examination of the four classes of the higher primary school (for young girls), or women who prove by an admission examination that they possess the requisite knowledge, are admitted to the commercial course.

The instruction is as a rule entrusted only to professors who have the qualifying diploma of the higher commercial schools. Should it be necessary, commercial arithmetic and the description of commercial articles may be taught by masters of higher primary schools who have the diploma for mathematics and natural science. Book-keeping, bills of exchange, and commercial correspondence are taught by persons having practical experience in these subjects.

The commercial course for women may be conveniently attached to a higher primary school for young girls, where the pupils find the desired school material. In every case it is deemed necessary that *a good collection of merchandise and a chemical laboratory* should be available, in order that the pupils may acquire the necessary conceptions.

The authorities or corporations which maintain the higher schools for young girls may organise similar courses.

The registration of entrance and the admission examinations take place in the early part of September, and the actual teaching commences about the middle of September.

31. *Internal Régime.—Examinations, Certificates.*—The pupils pay a school-fee determined according to the local conditions, the proceeds of which are devoted to the maintenance of the course. The fees are collected by the Director of the school with which the course is connected; he is charged with seeing to the requirements of the course, and with rendering regular accounts at the end of the school-year.

At the end of each month the professors assemble in conference, under the presidency of the Director.

Any pupil who has been absent, without reasonable excuse, on twelve occasions, is considered as having abandoned the course.

The hours of teaching are determined according to local conditions, but in no case must they be later than 5 o'clock in summer and 4 o'clock in winter. The number of hours each day is limited to three, or, in exceptional cases, to four. The pupils are constantly under the superintendence of a diplomaed mistress.

In the beginning of June the pupils undergo examination, each pupil being questioned on every subject in the programme. The Inspector of primary teaching, or his substitute, presides at these, and the Minister of Commerce has also his delegate present. Before the oral examination, the pupils undertake written compositions bearing on book-keeping, commercial correspondence, and commercial arithmetic. The theme of these compositions is determined by the Director-general of industrial teaching (belonging to the Minister of Public Instruction.)

Pupils who have passed the examination with success receive a certificate containing a classification. If the pupil has an insufficient mark for two subjects, she is admitted to a supplementary examination; if she fails in several subjects, she is obliged to repeat the course.

The certificate is signed by the President of the Commission, the delegate of the Minister for Commerce, the Director, and the professors of the course.

32. *Surveillance.*—The course is supervised by the authority which maintains it and by the Director, and, on the part of the Government, by the Inspector of primary teaching. The Minister of Instruction exercises the chief direction through the Director-general of industrial instruction.

The organisation and inauguration of a commercial course for women can take place only upon authorisation duly sought, through the channel of the Director-general of the Minister of Public Instruction. This restriction was found necessary, because courses were established in localities without commerce, and became so numerous that the leaving pupils had difficulty in obtaining positions. It was thought by the authorities that this was extremely undesirable.

33.

33. *General, in regard to the Courses for Women.*—Within a year of the publication of the regulation, and excluding courses established previously in the 5th arrondissement of Budapest, there were no less than 16 courses of commerce for women in 16 towns of the country. The number of pupils was 400, 363 of whom attended the course until the end. The courses received, besides school-fees, subsidies from the State and Chambers of Commerce. In the school-year 1897–98 there were 19 courses (5 at Budapest) with 812 pupils, 749 of whom passed the examination. The number of pupils of a course varied between 10 and 164.

The courses had 118 professors and 18 superintendents.

34. *General Summary.*—A review of the scheme of primary and commercial instruction in Hungary and other countries will reveal the fact that the Hungarian system is, in most respects, very satisfactory. Commercial teaching in Hungary is established on a very solid basis. It may be mentioned that Hungary received special acknowledgment at the International Congress of Commercial Education (at Antwerp in 1898), and at the International Congress of Orientalists at Paris.

The development of industry and commerce in Hungary is held to be quickened and perfected by the commercial instruction.

The authorities charged with the realisation of the task of providing an excellent form of commercial instruction spare neither effort nor expense.

The cost to the State of the commercial and industrial schools is regarded as more than repaid, since it serves to give to a hundred thousand future traders and merchants the instruction necessary for the economic, social, and political interests and development of the country.

The instruction of retail traders is held to be of great importance, and it is for this reason that the Hungarian State pays unremitting attention to the proper organisation and development of the apprentice-schools. The question of the possible careers to which women may be admitted awaken a lively interest, and the commercial courses for women are considered as institutions of great utility; and there are in Budapest many improvement schools, where young ladies who have left the primary school may receive complementary instruction in reading, calculation, drawing, book-keeping, manual work, and similar matters.

The higher commercial schools occupy a highly-esteemed place in the Hungarian scheme of public instruction, and their beneficent influence is felt in the Hungarian business world. The urgent requirements of practical life provoked the establishment of these schools; and while some of them are not conveniently situated, the defect will be remedied when a reform takes place in the higher primary schools.

The Hungarian commercial teaching differs somewhat from the same teaching in France. The commercial schools of France were organised exclusively to meet practical needs, and aim specially at the higher teaching; whilst in Hungary the primary and secondary grades of teaching are more strongly insisted upon.

In Hungary, where the supreme interest of the State is held to demand a uniform system for national teaching, the questions of education are intimately allied to the diffusion of the national spirit which it is important should also prevail in the world of Hungarian commerce; and this is why the high direction of commercial teaching should, according to the Hungarian view, lie with the same authority as that for the other branches of education. Further, it is believed that the commercial schools should be under the Ministry of Public Instruction, in order that the special teaching may be properly co-ordinated.

The present provision in Hungary is believed to be adequate for the needs of the people, excepting as regards the highest forms of commercial education—that is, of University grade. Further develo pmen may take place in that direction.

35. *Conclusion.*—Hungary, in company with other countries of Europe, has realised that the extension of national trade and commerce demands special forms of professional education for those who are to be engaged therein. The linguistic features qualify its citizens to speak and correspond in other languages, and thus the possibilities of commerce with other nations are increased.

The familiarizing the pupils with samples of raw and manufactured products, with the principles by which the purity and quality of goods are determined, with the practical contributions which the application of science has made to manufacture, trade, and commerce, is an extremely valuable means of reinforcing the powers of the people.

The whole scheme is valuable, and worthy of emulation.[1]

[1] It is proper here to acknowledge the indebtedness of the Commissioner to documents supplied by the educational authorities at Budapest. This information has been translated by the Commissioner, and embodied in this statement of Hungarian Commercial Education.

CHAPTER LIX.

CHAPTER LIX.

Commercial Education in Finland, Holland, Italy, Norway, Sweden and Russia.

[G. H. KNIBBS.]

1. *Introduction.*—The aim of this chapter is to give some indication of forms of commercial education to be found in various countries of Europe not already referred to, without in any way endeavouring to supply a connected account of the whole scheme of commercial education. In preceding chapters, the whole scheme of commercial education has, in some instances, been outlined; but in other cases, examples have been taken for the purpose of shewing the detailed development of the instruction. The present chapter may be regarded as of a supplementary character, and, excepting in one or two instances, the detailed development of the courses will not be referred to. The aim of the *ensemble* of chapters on commercial education is to give a sufficient number of examples to shew that abundant provision is made in Europe for commercial education, and that in its development the instruction is very thorough.

Everywhere it is recognised that thorough commercial education is a desideratum, and must be found in any educational system worthy of being considered complete.

2. *Commercial Education in Finland.*—Helsingfors, the Finnish capital, possesses a bi-lingual commercial institute, the instruction being given in both Swedish and Finnish. The course is a two-year one, with a preparatory class of one year. The programme is as follows :—

Programme of the "Handelsinstitutet i Helsingfors," Finland.

Subjects.	Classes and Hours per Week.		
	Preparatory.	I.	II.
Arithmetic	2	1	1
Algebra, Planimetry, Stereometry	7	1	1
Physics, Chemistry, Applied Chemistry	2	2	2
History and Geography	6	2	2
National Economy, Commercial Law, etc.	...	2	3
Book-keeping, Commercial Correspondence (Swedish, Finnish, Russian, German and English), Commercial Arithmetic, Commercial Bureau	...	6	10
Swedish	2 or 4	1 or 3	1 or 3
Finnish	4 or 2	3 or 1	3 or 1
Russian	3	3	2
German	4	4	2
English	...	3	3
Caligraphy	...	2	...
Total	30	30	30

The school was well equipped for practical instruction, especially in the Commercial Bureau section. The Commissioner saw it when evening classes were present.

3. *Commercial Education in Holland.*—Commercial education in Holland falls under practically three headings, viz., it may be :—

(1) A branch of a secondary school.
(2) A branch of higher primary education.
(3) Special instruction under the ægis of some association.

Illustrative examples may be taken. There is in Amsterdam, for example, a two year course in a public commercial school ("*Gemeentelijke hoogere burgerschool met handelsschool*"), in which the subjects taught are as follows :—

Languages.	*Commercial Subjects.*	
Dutch	Commercial Geography	Political Economy
French	History of Commerce	Commercial Law
German	Commercial Arithmetic	Book-keeping
English	Commercial Mathematics	Accountancy
Spanish*	Merchandise*	Caligraphy
Italian*	Commercial Chemistry	Stenography*
Swedish*		
Malay*		

There is a very similar school in Rotterdam, with a three-year course, omitting the subjects marked with an asterisk.

The

The "Netherlands School of Commerce and Industry" has a preparatory year for commerce. It teaches in this commercial section the following subjects, viz.:—

French 4, German 4, English 4, Geography 2, Chemistry 6, Zoology and Botany 1, Book-keeping 3, Commercial Arithmetic 3, Political Economy and Commercial Law 2, Practice in Mechanical Weaving 3, Drawing from Nature, etc., 2, Gymnastics 1.

The figures denote the number of hours per week.

There is a National Association in Holland for commercial employés, which gives (a) commercial courses at Amsterdam, Alkmaar, Delft, Deventer, The Hague, Groningen, Leeurvarden, Maastricht, Nimegue, Sneck, Utrecht, Zutphen ; (b) courses in book-keeping at Almelo, Breda, Bois-le-Duc, Vlissingen ; (c) stenography at Middelburg and Roosendaal ; (d) book-keeping and commercial correspondence at Euschedé.

4. *The Esmeyer Commercial School, Rotterdam.*—This is a private school, with at least 60 or 70 pupils in its commercial section. Its course is as hereunder :—

Subjects.	Classes and Hours per Week.				
	I.	II.	III.	IV.	V.
Caligraphy	1½	1	1	1	...
Stenography	...	1	1	1	1
Dutch	4	3	3	2	2
French	4	4	4	5	4
English	3	3½	5	5	4
German	4	4	5	5	4
Italian or Spanish... ...	...	...	...	...	4
Arithmetic...	3	1	1	...	...
Algebra	2	2	1	...	...
Geometry	1	2	2	...	...
Commercial Arithmetic ...	...	1	1½	3	4
Book-keeping	...	...	...	3	4
Sacred History	1	1	1	1	1

Subjects.	Classes and Hours per Week.				
	I.	II.	III.	IV.	V.
National History ...	...	1	1	...	...
Universal History ...	2	1	1	...	...
Commercial History ...	...	...	...	1	1
Geography	2	2	2	2	...
Natural Science... ...	1	1	1	...	...
Constitutional Law ...	...	...	...	½	...
Commercial Law ...	...	...	...	1	1
Political and Social Economy	...	...	...	1	1
Freehand Drawing ...	1	1	1	...	...
Gymnastics	2	2	2	2	2
Total	31½	31½	33½	33½	33

The age of entry into the commercial section is 12-13 years.

5. *Commercial Education in Italy.*—Italy possesses several grades of commercial education ; for example, the Royal Higher Schools of Commerce, the Elementary Commercial Schools, the Commercial Schools for Women. Examples will be given shewing the type of each.

Where the Commissioners had an opportunity of seeing the equipment for teaching it was good.

One of the higher schools, viz., that at Venice, is housed in the *Palazzo Foscari*, on the Grand Canal. Its equipment for commercial teaching is very good. It may be mentioned that 2 out of its 150 pupils were young women, and it was rumored at the date of the Commissioner's visit that there was to be a large influx of female students.

6. *Commercial School of Turin.*—Annexed to the "*Istituto Tecnico Germano-Sommeiller di Torino.*" This school was referred to in an early part of this report. There is a school of commerce, "*Scuola tecnica e pratica di commercio,*" with a three-year course, the first year being preparatory. Pupils possessing the licenza of the primary schools are admitted to the preparatory class. There are over one hundred pupils, one-third being young women.

The programme is as hereunder :—

Programme of the "Scuola tecnica e pratica di commercio," Turin.

Subject.	Years, and Hours per Week.		
	I.	II.	III.
Caligraphy	6	6	6
Physical Geography	2	...	...
Commercial Geography	...	3	...
French Language	6	6	6
Italian Language	12	8	8
Mathematics	6	6	...
Accountancy	...	4	9
Political Economy and Commercial Law ..	...	...	3
Customs Operations and Tariffs	...	...	2
Carriage and Freights (railway)	...	...	4
Totals	32	33	38

This does not exactly represent the normal course in the technical schools, which is referred to in the next section.

7. *Commercial Education in Technical Schools, Italy.*—The normal course in the lower technical schools ("*scuole tecniche*") with a commercial orientation ("*con indirizzo commerciale*") is as follows:—

Programme of the "Scuola tecnica con indirizzo commerciale."

Subjects.	Classes and Hours per Week. I.	II.	III.	Subjects.	Classes and Hours per Week. I.	II.	III.
Italian	6	5	5	Drawing	4½	1½	...
French	3	3	4	Caligraphy	3	2	2
English or German	...	4	4	Geography	2	2	2
Mathematics	4	2	2	Accountancy[2]	...	3	5
Natural Science	...	3	3				
History and Civics[1]... ...	2	2	2	Totals	24½	27½	29

The relations of technical schools (*scuole tecnici*) to technical institutes (*istituti tecnici*) has been explained earlier in the Report[3]. Reference may now be made to Commercial education in the higher institution, *i.e.*, the Institute.

8. *Commercial Education in the technical institutes of Italy.*—A very large number of the "*istituti tecnici*" have a commercial and accountancy section ("*Sezione di commercio e ragioneria*"), for example, the "Caio Plinio II" at Como, the "Galileo Galilei" at Florence, the "Vittorio Emanule II" at Genoa, the "Carlo Cattaneo" at Milan, the "Giovanni Battista della Porta" of Naples, the "Leonardo da Vinci" at Rome, the "Paolo Sarpi" at Venice, and many others.

The normal programme[4] is as follows:—

Programme of the "Sezione di Commercio e Ragioneria" of the "Istituti tecnici" of Italy.

Subjects.	Classes and Hours per Week. I.	II.	III.	IV.
Caligraphy	......	2	1	2
General Chemistry	......	......	3	......
Accountancy and Book-keeping	......	4	5	9
Civil Law	......	......	3	......
Commercial and Administrative Law	......	......	......	4
Ornamental Drawing	6	......	......	......
Political Economy	......	......	3	......
Financial Science and Statistics	......	......	......	4
General Physics	......	......	5	......
Geography	3	3	......	......
Italian Literature	6	5	4	6
French Language	3	3	2	2
English or German Language	......	3	5	5
Logic and Ethics (now abandoned)	......	(2)	......	......
Mathematics	6	5	......	......
Zoology and Botany	3	......	......	......
Mineralogy and Geology	......	3	......	......
General History	3	3	2	......
Totals	30	31	33	32

9. *Details of the Commercial Course in the Italian Technical Institute.*—It will suffice to refer to two or three subjects only, as the others have either been referred to already or do not call for special mention.

Accountancy and Book-keeping (Computisteria e ragioneria).

Class II.—(1) Distinction between general and concrete arithmetic, matters to which the latter applies. (2) Measures, etc., Italian and Foreign and reductions. (3) Currency, Italian and Foreign, and parities of currency. (4) Mixture, alligation, questions of cost. (5) The noble metals and questions of

1 "Storia e diritti e doveri."

2 Computisteria.

3 See also Commissioners' Report on Secondary Education, chap. XXV., sect. 8, p. 304.

4 See: —R. decreto 21 giugno 1885, n. 3413, che approva il regolamento generale, per gli istituti tecnici, and also R. decreto 4 ottobre 1889 n. 6484, che sopprime le due sotto sezioni speciali di commercio e ragioneria *privata*, etc., etc. For the programme itself, see Codice pubblica istruzione, vol. ii., p. 292. Saredo, Torino, 1899.

of alligation. (6) Percentage calculations. (7) Simple interest modes of calculation. (8) Simple discount and modes of calculation. (9) Equations of time and interest. (10) Distribution, etc., simple and compound. (11) Exchange, direct, indirect, mercantile arbitration, etc. (12) Public and private funds, operations on the Bourse, etc. (13) Compound interest. (14) Compound interest. (15) Annuities. (16) Amortisations. (17) Accounts—current.

Class III.—(1) Economic administration, its scope and methods. (2) Domestic economy, private, public. (3) It species—domestic, patrimonial, rural, commercial, industrial, etc. (4) Public economy, communes, provinces, states, benevolence, saving banks, providence and pensions. (5) Classification of administrative affairs from an economic, juridical and administrative aspect. Property, wealth, capital, fixed and circulating capital; property, rights; property according to the civil code; rights and obligations of property; divisible and indivisible property; disposable and non-disposable; productive and non-productive wealth and capital. (6) Organs of economy, proprietors, administrators, administrative agents in general, etc. (7) Economic organisms, simple and complex economics. (8) Administrative functions, initial, executive, final. (9) Constitution and organic development of economics in general and of particular forms thereof; laws which govern them, constitutive acts. (10) Patrimony, active and passive wealth, principal funds and accessory capital. (11) Recognition of the elements of wealth (*sostanza*), classification. (12) Evaluation of the active and passive forms, theoretical practical rules. (13) Inventory. various species of same; responsibility of administrators and their agents. (14) Returns, profit and loss, production and consumption, etc. (15) Balance, its scope and form. (16) Classification of returns, various forms of balance. (17 to 19) Deal with ordinary business operations and values. (20) Economic periods, the solar, agricultural and financial years. (21) Rendering of accounts, moral, economic and administrative and juridical aspect.

Under a sub-heading, "Accounts and Methods" ("*Dei conti e dei Metodi*") sects. (1) to (9) deal with definition of accounts, their function and essential elements, their juridical, economical and statistical character and their various forms; proprietors' accounts, those of an agent or correspondent; accounts of values; chronological systematic entries, the necessary instruments therefor; elementary and complex book-keeping, the general theory of its methods; book-keeping by single entry, its contents and function; the theory of balancing and book-keeping by double entry, and matters relating thereto, are also treated.

In *Class* IV. the work is as follows:—(1) *Accountancy, applied to domestic and patrimonial economy.* (2) *Industrial and commercial economy, public economy. Special functions of accountancy.* Under these headings a very complete scheme of instruction in accountancy is developed and taught. As there is a general resemblance to other higher expositions already given, it is not proposed to give further indication of detail.

Elements of Economic Science.

This is given in *Class* II. for 3 hours per week. Political economy in this class is treated by commencing with an introduction defining economic facts and the nature of economic science. It proceeds to define the character of social science, its office, its relation with ethics and jurisprudence, and its divisions. It is divided into general and special parts, the first treating of production, circulation, distribution, consumption of wealth, and of the general history of economic science. The second part deals under the same headings with details. For example, in the general part, under the heading Production, the general conception of production; various species of productive labour; the part that nature, matter, and natural forces contribute; the general notion of industry; the idea of labour, its liberty and divisions; the idea of capital, its origin, its form and importance; the relations of machinery to manual labour, and of the freedom of union of labour and capital are discussed. Under the same heading, in the special part, what are called extractive, manufacturing, commercial and carrying industries, insurance and commercial companies, are among the matters expounded.

The *elements of financial science and of statistics* are discussed in Clause IV, these dealings with the general theory of public finance, public expenditure, public income coming under the first heading, and the general aim and function of statistics under the second.

10. *The Municipal Commercial School for Young Women at Rome.*—Rome possesses a commercial school for young women, founded in 1888. Girls are received therein from 11 to 16 years of age, but must possess the elementary Licence of the Primary School, or else pass the examination in the subjects taken in the 5th elementary class. The course lasts four years, and a special certificate ("*Licenza*") is given to those who pass satisfactorily the final examination. The programme is as follows:—

Programme of the Commercial School for Young Women, Rome.

Subjects.	Years, and Hours per Week. I.	II.	III.	IV.	Subjects.	Years, and Hours per Week. I.	II.	III.	IV.
Italian	5	4	3	3	French	5	3	3	3
Accountancy	...	...	3	4	German	...	4	4	4
Arithmetic	5	3	3	3	English	...	4	4	4
Merchandise	2	2	2	2	Caligraphy	2	2	2	2
Geography	2	2	1	1	Drawing	3	3	3	3
History	2	2	2	2	Needle-work, etc. ...	3	3	3	3

11.

11. *The Royal Higher School of Commerce in Venice.*—This school was founded in 1868, and as previously stated is established in the Palazzo Foscari, on the Grand Canal.

It aims at supplying an education for the following persons, viz. :—

(1) Those who wish to have a good commercial education for practical reasons.
(2) Those who desire to learn modern European languages.
(2) Those who wish to enter the Consular career.
(4) Those who wish to become professors or teachers of commercial schools.

The school is divided really into three sections, viz., the commercial, consular, and normal or teaching section. The last is again divided into the law, economics, and statistics division, and the merchant accountancy, and foreign languages divisions. The tables hereunder will disclose the subdivisions fully.

Pupils are received at the age of 16 years, provided they possess the license (*licenza*) of an industrial technical institute of the Kingdom, or, failing this, pass an equivalent examination.

Besides the regular students, a certain number of irregular students are admitted for the purpose of attending one or more special courses. They are not free, however, to attend the commercial practice.

The following fees are payable to the school :—

Inscription for the first year, 150 lire (£6) ; for each following year, 100 lire (£4).

Irregular students, each subject, first year, 15 lire (12s.); for each subsequent year, per subject, 10 lire (8s.).

For the certificate of attendance, each regular pupil pays 50 lire (£2), and each irregular student, per subject, 5 lire (4s.)

The complete course lasts five years, and is developed as indicated in the prospectus or programmes hereunder.

R. SCUOLA SUPERIORE DI COMMERCIO IN VENEZIA

PROSPECTUS OF THE SUBJECTS OF INSTRUCTION.

First Year.

Common Class.	Teaching of Foreign Languages Class.	Hours per Week.
Italian Literature	Italian Literature	4
French Language	French Language } any one language.	3
German "	German "	5
English "	English "	3
Economic Geography	....	2
Accountancy	....	3
Algebra	....	3
Merceology (Merchandise) ...	....	3
Commerce	....	3
Civil Law	....	3
Caligraphy	....	3

Second Year.

Commercial Class.	Consular Class.	Teaching Classes.				Hours per Week.
		Law, Ecomomics, Statistics.	Merceology.	Accountancy.	Foreign Languages.	
Italian Literature	Italian Literature	Italian Literature	Italian Literature.	Italian Literature	Italian Literature.	2
French Language (2).	French Language	French Language	French Language.	French Language (2).	According to language desired.	4
German Language (4).	German Language.	German Language.	German Language.	German Language (4).		5
English Language (3).	English Language	English Language	English Language.	English Language (3).	....	4
Economic Geography.	Economic Geography.	Economic Geography.	Economic Geography	....	....	2
Commerce ...	Commerce ...	Commerce ...	....	Commerce ...	....	1
Accountancy ...	....	....	....	Accountancy ...	....	2
Commercial Arithmetic.	Commercial Arithmetic.	....	....	Commercial Arithmetic.	....	3
Merceology ...	Merceology ...	Merceology ...	Merceology	....	....	2
Commercial and Maritime Law.	Commercial and Maritime Law.	Commercial and Maritime Law.	....	Commercial and Maritime Law.	....	3
Commercial Practice.	....	....	....	Commercial Practice.	....	2
Caligraphy ...	....	....	....	Caligraphy ...	....	1
....	Civil Law ...	Civil Law ...	....	....	....	2

Third

Third Year.

Commercial Class.	Consular Class.	Teaching Classes. Law, Economy, Statistics.	Teaching Classes. Merceology.	Teaching Classes. Accountancy.	Teaching Classes. Foreign Languages.	Hours per Week.
Italian Literature	Italian Literature	Italian Literature	Italian Literature.	Italian Literature	Italian Literature.	2
French Lang. (2)	French Language	French Language	French Lang	French Lang. (2	According to language desired	4
German ,, (3)	German ,,	German ,,	German ,,	German ,, (3)		5
English ,, (3)	English ,,	English ,,	English ,,	English ,, (3)		5
Accountancy ...	....	....	....	Accountancy ...	....	2
Merceology ...	Merceology ...	Merceology ...	Merceology...	....	....	2
Commercial Law	Commercial Law	Commercial Law	....	Commercial Law	....	3
History of Commerce.	History of Commerce.	History of Commerce.	History of Commerce.	....	....	2
Economic Geography.	Economic Geography.	Economic Geography.	Economic Geography	....	Students who take French attend the School of Commercial Practice.	2
Political Economy.	Political Economy.	Political Economy.	....	....		2
Commercial Arithmetic.	....	....	....	Commercial Arithmeti		1
Commercial Practice.	....	....	....	Commercial Practice.		8
Caligraphy ..	....	....	....	....		1
....	Civil Law ...	Civil Law ...	....	....		2
....	....	....	....	Professional Accountancy.		3
Third Year Diploma of Licenza						

Fourth Year.

Consular Class.	Teaching Classes. Law, Economy, Statistics.	Teaching Classes. Merceology.	Teaching Classes. Accountancy.	Teaching Classes. Foreign Languages.	Hours per Week.
French Lang. (3) ...	....	....	....	French, German, English — Any one of these	3
German ,, (3) ...	....	....	....		4
English ,, (3) ...	....	English (3) ...	....		4
Political and Diplomatic History.	....	....	....	....	...
	Political and Diplomatic History.	....	....	....	...
		Didactic Exercises in Merceology.	Didactic Exercises in Accountancy.	....	2
International Law...	International Law	....	Professional Accountancy.	....	3
Civil Law	Civil Law	....	....	....	2
....	....	....	Commercial Practice.	Commercal Practice.	10
Constitutional Law	Constitutional Law	....	....	....	3
Criminal Law and Procedure.	Criminal Law and Procedure.	....	....	....	2
Political Economy...	Political Economy	....	....	....	2
Financial Science ...	Financial Science...	....	....	....	1
Theoretical Statistics	Theoretical Statistics	....	....	....	3
....	Administrative Law	....	....	....	3
		Licentiate Diploma of Fourth Year.	Licentiate Diploma of Fourth Year.		

Fifth Year.

Consular Class.	Teaching Classes: Law, Economics, Statistics.	Teaching Classes: Foreign Languages.	Hours per Week.
French Language (3)	....	French Lang. } Any	3
German „ (3)	....	German „ } one of	4
English „ (3)	....	English „ } these	4
Political and Diplomatic History ...	Political and Diplomatic History ...	....	2
....	....	Commercial Practice	10
International Law	International Law	....	3
Constitutional Law	Constitutional Law...	....	3
Criminal Law and Procedure ...	Criminal Law and Procedure ...	....	2
Civil Law	Civil Law	....	2
Political Economy	Political Economy	....	2
Financial Science	Financial Science	....	1
Theoretical Statistics	Theoretical Statistics	....	3
....	Administrative Law	....	2
....	Rural Legislation	....	3
....	Didactic Exercises in Economy, Statistics, Financial Science, Civil and Commercial Law	.... Didactic Exercises in the French, German, and English Languages.	... ...
Fifth Year Diploma	Fifth Year Diploma	Fifth Year Diploma	...

The above tables disclose the scheme for each branch of instruction. Where bracketed figures are shewn it implies that the hours per week are special for that subject. Thus, in the second year English is five hours for three or four divisions, and only three hours in the Accountancy Teaching and the Commercial Class.

12. *Commercial Education in Norway.*—In Kristiania, the capital of Norway, there is a Commercial gymnasium, the courses in which are founded on a Middle school (*middelskole*) preparation. This was established in 1875.

It has "forenoon" classes from 8 to 2[1] for boys, the programme being as follows:—

Programme of the "Kristiania Gymnasium," Norway.

Subject.	Class and Hours per Week. I.	II.	Subject.	Class and Hours per Week. I.	II.
Commerce	1	1	German	4	4
Commercial Law	...	2	French	5	4
National Economy	...	2	English	3	3
Commercial Arithmetic	4	4	Commercial Correspondence ...	1	1
Merchandise, Chemistry	3	2	Physics	1	1
Geography & Commercial Geography	2	2	Writing	2	(1)
Book-keeping and Com. Bureau ...	4	6			
General and Commercial History ...	2	2	Total	36	36
Norwegian	4	2			

The afternoon course for young women ("*Det kvindelige Eftermiddagskursus*") is from 4—7 or 8; *Stenography* is from 8·30 – 9·30 in the forenoon, and both boys and girls learn typewriting.

The time for the various subjects for the course for young women is as follows, the number denoting the hours per week:—

Commerce and Commercial Law, 1; Commercial Arithmetic, 3; Book-keeping and Work in the Commercial Bureau, 3; Commercial Correspondence, 1; Norwegian, 2; German, 3; English, 3; Caligraphy, 2; total, 18 hours weekly.

13. *Commercial Education in Sweden.*—The internal commerce of Sweden is active, and its foreign commerce rapidly developing; hence commercial education is becoming of increasing importance.

The first commercial school of any note was that established by Wurmb, Secretary to the Board of Trade, at Öringe, in Holland, and as many of the prominent merchants of Gothenburg (Göteborg) had received their education there, it has been the initial influence in giving form to Swedish ideas as to what should be embraced in commercial education.

As far back as 1734 a trade statute (*Handelsförordning*) had established a fixed period of apprenticeship to commerce, usually from 11½ to 12 years, and even then the applicant had to prove the competency of his knowledge before two commercial men! In

[1] "Undervisningen er fra 8—2 om Formiddagen."

In 1823, Parliament (the *Riksdag*) urged upon the Crown the desirableness of establishing commercial schools (*Handels-skolor*) or a Central Commercial and Navigation Institute (*Central Handels-och Navigations-Institut.*). The proposal was referred to the Trade Societies of Gothenburg (*Handelsocieteten i Göteborg*), and the Commercial Institute of that City was then founded.

14. *Gothenburg Commercial Institute.*—This institution, known in Sweden as the "*Göteborgs Handelsinstitut,*" has a two-year course, and an additional professional course for pupils who pass the final examination of the higher state schools (which admits to the University). Except by special permission, candidates for admission must be less than 18 years of age for the lower courses, and must be qualified to enter the 6th class of the higher State School.

The programme of the school is as follows :—

Programme of the "Göteborgs Handelsinstitut," Sweden.

Subject.	Classes and Hours per week.		
	I.	II.	Profess
Swedish	2	2	......
German	5	5	5
English	5	5	5
French	5	5	4
Commercial Geography	2	2	2
Political law	......	1	......
Commercial law	......	2	2
National economy	......	1	1
Commerce	1	1	1
Book-keeping, counting-house work, commercial correspondence	3	4	5
Commercial Arithmetic	5	2	3
Arithmetic of economics	......	......	1
Physics	1	......	......
Chemistry	2	3	3
Stenography	1	1	1
Caligraphy	2	......	1
Type-writing (optional)	(2)	......	......
Spanish (optional)	......	(2)	(2)
Totals	34 (36)	34 (36)	34 (36)

Visits are systematically paid to factories and other industrial establishments. The school year is 40 weeks, opening on 26th August and closing on 14th June.

The fees are 280 kronor (£15 18s.) for the first-class and 320 kronor (£17 12s.) for each of the other classes, but there are about 27 pupils paying absolutely nothing, and pupils who are not well-off may be charged 100 kronor (£5 10s.) instead of the higher sum ; 59 pupils are so treated at the present time.

About 137 pupils are attending the two-year course, 38 of whom are women, and 42 the professional course, 179 in all.

The development of the Commercial school was largely due to the *Renström*[1] endowment.

15. *The Schartau Commercial Institute.*—This *Handelsinstitut* is situated at Stockholm. It has a two-years' course and further two one-year courses. The instruction is similar to that of the Gothenburg school, the course running from 1st September to 31st May. The fee is 225 kronor (£11 17s.) for each class. The attendance is 111, 37 being women ; 22 scholars are free, 24 pay only 100 kronor.

16. *Other schools for commercial education, Sweden.*—The Burger school (*Borgarskola*) of Gefle[2] has a section with a two-year course in commercial education, and is specially orientated with regard to the timber trade.

At Sundsvall[3] there is also a Commercial Institute (*Handelsinstitut*) ; many schools have some commercial teaching in their courses.

17. *Commercial Education in Russia.*—Just 100 years after the birth of Peter the Great, to whose influence Russian professional education owes its very existence, the *first Russian commercial school* was founded in Moscow (in 1772). This was owing to the liberality of Procopé Demidoff[4], whose donation for the purpose amounted to 205,000 roubles (about £22,000). It was intended for the education of 100 merchants' sons, and its programme included the following, *viz.* :—

Religion	Mechanics	Imperial Law	All Branches of Commerce
Russian	History	Economics	Drawing
Foreign Languages	Geography	The Arts and Crafts	Dancing
Arithmetic	Nautical Science	Accountancy	Courtesy, Manners
Geometry	Navigation	Russian and Foreign Accountancy	
Algebra	Natural History		

The children were received at 5 years of age, and it has six divisions of three years each.

In

[1] Sven Renström (1794-1869), a Gothenburg merchant, bequeathed 1,500,000 kronor to that city (£82,500), one-third to be available at once, and the balance to be invested till the accumulated interest amounts to 500,000 kronor, when it is to be applied.

[2] Gefle, a town of about 30,000 inhabitants, is about 114 kilometres northerly from Stockholm, on the west of the Botten Hafvet (Gulf of Bothnia).

[3] A town of say 15,000 inhabitants, about 1½° north of Gelfe ; also on the east coast of Sweden.

[4] The Demidoffs are a very wealthy and very generous Russian family.

In 1804, at Odessa, and in 1806, at Taganrog, ***commercial gymnasia*** were established. In 1804, two special commercial schools were established also at Moscow[1]. Commercial schools then multiplied with fair rapidity. In 1835, accountancy and the elements of mineralogy and geology were to be found in a commercial school in the District of Ekaterinburg; and in 1836, accountancy, with an explanatory course as to the elements of jurisprudence, and judiciary law in Vedensky. In 1838, the Taganrog Gymnasium added accountancy, Italian, and a special course in commerce.

The history of the whole movement is too lengthy for recitation; it will be sufficient to observe that the demand for commercial education multiplied very rapidly.

The closing twenty years of the 19th Century saw a rapid development in the number of women commercially employed in Russia, and provision for their education was a necessity.

From 1890 to 1894 there was considerable agitation for improvement, and the Finance Ministry elaborated a law for commercial education which received the Imperial sanction on 15th April, 1896.

18. *Organisation of Commercial Education in Russia.*—The law above referred to constituted two types of schools, viz. :—

I. { Commercial Schools (general), with seven-years course.
Commercial Schools (special), with three-years course.

II. Courses in Commercial Science for adults already in commercial employment.

The seven-year schools give general and special education. They admit children at 10 to 12 years of age. The work for the first five years is akin to that in the Real School[2]; it is, however, slightly abridged.

For an illustration of the work in this type of school reference should be made to the Commissioners' report on Secondary Education[3].

It may be mentioned that special attention is given to conversational facility in foreign languages.

The school of commerce of three classes is practically identical with the three upper-classes of the 7th class school.

The type of work for the elementary school of commerce of three is practically as follows :—

Type—Programme of Elementary School of Commerce of 3 *classes.*

Subjects.	Classes and Hours per week.		
	I.	II.	III.
Religion	2	2	2
Russian	5	3	3
Commercial arithmetic and elementary ideas of Alegbra	5	4	3
Elements of Geometry	2	2	......
Book-keeping	......	4	6
Commerce and elements of commercial and industrial law	2	2	3
Correspondence	......	......	2
Commercial Geography of Russia	3	3	3
History of Russia	2	2	......
Study of merchandise of the district	3	3	4
Writing	2	2	1
German (optional)	6	6	6
Totals	32	33	33

The courses of Commercial Instruction for Adults, instituted by the law of 15th April, 1896, are very variously organised. In 1900 there were about ten Commercial Schools with 2,746 pupils, and twenty courses in Commercial Science with 867 pupils; the total number receiving commercial instruction in Secondary Schools for Commerce (40) being 10,610, that is a total of 14,223 in a total of eighty schools.

There is in St. Petersburg a society for the promotion of commercial science, and in many other parts of Russia merchants organise to promote commercial education.

A commercial school worthy of special mention is that known as the "Peter-the-Great" School of Commerce. Pupils receive at the end of their course a certificate which gives them a special status as citizens, if they do not already enjoy it by right of birth, they have also the right (after passing the necessary examinations) to teach in the higher schools; further, their compulsory military service is reduced to one year.

Pupils who pass with special credit receive a title, which may be translated "Licentiates in Commerce.'

The

[1] Owing to rivalry between St Petersburg and Moscow !

[2] See the Commissioners' Report on Secondary Education, chap. XXVI., pp. 308-314.

[3] *Ibid.*, p. 311.

The following programme will give some idea of the work in the school:—

Programme of the Peter-the-Great School of Commerce.

Subjects.	Classes and hours per week.								Total.
	Preparatory.	I.	II.	III.	IV.	V.	1 Spec.	2 Spec.	
Religion	3	2	2	2	2	2	2	2	17
Russian	6	6	5	4	4	3	2	2	32
French	...	6	6	6	4	3	3	3	31
French commercial correspondence ...	...	...	...	...	...	...	2	2	4
German	6	6	4	4	3	3	3	3	32
German commercial correspondence ...	...	...	...	...	...	...	2	2	4
English	...	...	2	2	4	4	3	3	18
English correspondence	"	...	...	...	...	...	2	2	4
Arithmetic...	6	4	5	2	2	...	...	...	19
Algebra	...	...	...	3	3	3	...	...	9
Geometry	...	...	...	...	2	2	1	...	5
Trigonometry	...	...	...	...	...	1	...	...	1
Physics	...	...	...	...	2	3	3	...	8
Chemistry	...	...	...	...	..	..	3	2	5
Chemical laboratory	...	...	...	...	...	...	...	3	3
Natural History	...	...	...	2	2	3	1	...	8
Geography...	..	2	2	2	2	2	...	...	10
History	...	...	...	2	3	2	3	...	10
Political economy	...	...	...	...	...	...	2	2	4
Commercial Geography	...	...	...	...	...	...	2	2	4
History of commerce	...	...	...	...	...	...	...	2	2
Commercial legislation and law	...	...	...	...	...	...	...	4	4
Merchandise	...	...	...	...	...	...	2	3	5
Commercial Arithmetic	...	...	...	...	...	...	3	...	3
Book-keeping	...	...	...	...	...	...	...	5	5
Caligraphy...	3	2	2	2	1	1	1	1	13
Drawing	4	2	2	2	...	...	...	...	10
Dancing	1	1	1	1	1	1	...	...	6
Gymnastics	1	1	1	1	1	1	...	...	6
Totals...	30	32	32	35	36	34	40	43	282

About fourteen pupils can work in the laboratory at one time.

The library of this institution has 5,769 volumes, the commercial cabinet 1,093 samples of natural products, 178 models, etc., for their study, 98 diagrams, microphotographs, etc.; the cabinet of natural history 264 objects, anatomical preparations, etc., and also splendid wall diagrams. There is also a considerable collection of minerals. The total value of the school is about £67,000.

The programme of the "Alexander" Higher School of Commerce of Moscow is very similar, and is not therefore given.

19. *Concluding Remarks.*—A sufficient general indication has now been given of the effort made in Europe to provide a comprehensive scheme of commercial education. Briefly, it may be summed up by saying that there is usually an elementary form, either in the primary school or in continuation schools; that the commercial schools proper are what may be called "secondary schools of commercial instruction," and that they supply both the theoretical and practical elements necessary for good commercial training.

The commercial high schools and academies must be regarded as commercial Universities.

Throughout, the teachers in these schools are specialists in the subjects of their lessons or lectures. The equipments are good. Each higher school has the means of testing chemically and physically all ordinary commercial products. They possess extensive museums of raw and manufactured material, and commercial men and the proprietors of industrial establishments are generous in presenting commercial and industrial objects for museum purposes.

Secondary education such as is afforded in Europe, followed by a course in a higher school of commerce, is a much more thorough commercial preparation than the type of higher education in commerce to be found so far in the United Kingdom, but it is also to be noted that rapid progress is being made in English commercial education.

Probably Australia as a whole could support a single University of Commerce.

CHAPTER LX.

CHAPTER LX.

Commercial Education in Berne, Geneva, Lausanne, and Winterthur.

[G. H. KNIBBS.]

1. *Introduction.*—Swiss provision for commercial education is excellent, and the Academy of Commerce at Neuchâtel, referred to later, an excellent example of a Commercial University. It is proposed to give in this chapter some idea of commercial education of a lower grade than that of Neuchâtel, for both sexes.

2. *Commercial School for Girls, Berne, Switzerland.*—The finest-looking schoolhouse in Berne is the "*Schulhaus Monbijou,*" shewn on page 418 of the Commissioners' Report on Primary Education. It is a Municipal School (*Städtischen Mädchenschule*), and in its higher division (*Oberabteilung*), it has made provision for the commercial education of young women. This school is very finely organised and equipped.

The general programme is as follows:—

Programme of the "Töchter-Handelsschule in Bern," Switzerland.

Subjects.	Years and Hours per Week.			Subjects.	Years and Hours per Week.		
	III.	II.	I.		III.	II.	I.
Obligatory—				Obligatory—			
German Language	6	4	2	History	2	2	...
„ Correspondence ...	1	1	2	Political Economy	...	...	2
French Language ... } „ Correspondence }	8	4	4	Writing, Stenography ...	4	3	...
				Bureau, Machinery	...	1	3
Arithmetic	4	3	3				
Book-keeping	2	3	3	Optional—			
Science of Commerce and Exchange	1	1	2	English	...	4	4
				Italian	...	3	3
Physics, Natural Philosophy...	...	2	...	Singing	2	2	1
Knowledge of Merchandise ...	...	...	1	Needlework	...	3	...
Geography	2	2	2				

3. *Pædagogic and General Organisation.*—The condition under which it is possible to study in other countries being of interest to those who desire to understand our place in the educational world, the general and pædagogic organisation is referred to.

The Commercial School for Girls, with the Teachers' Seminary and the Continuation classes, constitutes one of the higher series of classes in the Municipal Girls' School, Berne. It affords preparatory technical instruction for mercantile business management, book-keeping, the work of a cashier, and for correspondence and counting-house practice generally. There are three courses of one year each, the age necessary for entrance into the lowest class being 15 years.

Candidates must prove by an Entrance-Examination that they possess "that knowledge and skill which can be attained by capable scholars, up to the age of 15 years, after successfully passing through a Secondary, District, or Realschool, or the corresponding classes of the higher Middle schools." (This is by way of satisfying a resolution of the Confederation with reference to the advancement of commercial education. 17th November, 1900, Art. 2, litt. 6.) Admission is granted to candidates who have qualified in the ninth school-year of a Municipal or advanced upper Primary school of the Canton of Berne. They are examined in the following subjects on the basis of the plan of instruction of the school in question:—

German (reading, reproduction, composition); *French* (reading, reproduction, dictation); *Arithmetic* (oral, mental, written); and the *geography of Switzerland.*

Candidates with sufficient knowledge in these subjects may undergo the examination for admission to Class II; Class III being really a preparatory class.

Entrance into the higher classes, moreover, follows from promotion or as the result of an examination, which is based on the work of the preceding class.

The yearly school-fee is 60 fr. (say £2 8s.) for entrance, and there are extra promotion fees of 5 fr. (4s.) and 2 fr. (1s. 7d.) respectively.

For scholars of *French* Switzerland there is a *special course* in the *German* language with four to six hours per week, the fee for the course being 30 fr. (£1 4s.) There is also a special course in the *French language* for such scholars who are deficient therein, for four hours per week, the fee for the course being 20 fr. (16s.)

Details

Details of Organisation.

The *curriculum* of the School provides for 24–30 hours of obligatory instruction per week. In the third-year courses the afternoons may be devoted to practical work in the various mercantile establishments, or in the post and telegraphic bureaux of the city.

There are a number of *type-writers* of the best make, and also *Mimeographs* and "*Schapirographs,*" for the multiplication of copies. The pupils have abundant opportunities for practice, and also speed practice in Stenography, so that they may become thoroughly qualified for taking a position in a commercial establishment.

Pupils receive *Quarterly Certificates*, and at the termination of the advanced courses, *Leaving Certificates.* These are necessary for admission to the final and Diploma examination.

This *Final Examination* takes place at the conclusion of the courses, under the supervision of the "School Commission" and an expert named by the "Direction" of Public Instruction for the Canton. The examination is both written and oral. The results, together with the quarterly certificates, determine the marks in the individual subjects for the *Diploma.*

The school year begins, as a rule, in the latter half of April, and terminates at the end of March; and the entrance examinations are held at the end of that month. The vacations are as follows:—Summer, 4 weeks; Autumn, 3 weeks; the New Year, 1-2 weeks; and Spring, 2 weeks.

For scholars in straitened circumstances, four free places per class are provided. These are granted on half-fees or are wholly free, according to circumstances. To those whose parents do not reside in the city, the Government grants *allowances* to the value of from 50–150 fr. (£2 to £6) yearly from the annual credit set apart for this purpose.

The Principal of the Upper Division has the superintendence of the board and lodging of those pupils whose parents do not live in Berne, and the Commission is empowered to prohibit unsuitable board and residence without being obliged to state the reasons.

Foreign pupils just entering the school may obtain from the Principal of the Girls' School a list of the most suitable houses where board and residence may be procured. For this purpose a number of offers exist, giving detailed accounts of the aspect and condition of the rooms to be disposed of, the board, society, and terms. The cost amounts to, according to offer and demand, 500–1,000 fr. (£20 to £40) yearly, and on special request the Principal even arranges to accommodate the boarder.

The school provides means, to a reasonable extent, for the preservation of the physical health and invigoration of the pupils entrusted to it; sees, also, that the educational opportunities afforded in the city itself are availed of, such as collections, exhibitions, industrial institutions, etc. For bathing and swimming during the Summer, and of douch bathing (School-house) in the Winter, the necessary time is granted and the requisite care exercised. In the Summer, long and short excursions to the country are undertaken.

The Institution possesses a *Library*, which is at the free disposal of the scholars, and offers special scientific as well as entertaining reading.

The pupils of the Upper Division are permitted to partake of a Domestic Economy and Health (First Aid) Course. For the former, including the food cooked and eaten, a fee of 5 fr. (4s.) per pupil is charged.

4. *Details of Courses in the Monbijou Commercial School for Girls.*—The following details will disclose the development and grade of the instruction.

Class III (Preparatory Course).

German (6 hours per week).—Treatment of prose and poetical reading selections. Exercises in oral expressions. Compositions. Grammatical exercises for obtaining certainty in composition.

French (8 hours per week).—Grammar. Translations. Dictation. Reading. Conversation. Recitation. Easy letters and essays. Exercise on the use of the irregular verbs.

Arithmetic (4 hours per week).—Progressive exercises in sure and rapid operations with whole numbers, vulgar and decimal fractions. Practice in reduction. Money, weights and measures, and problems concerning them. Calculations in simple interest and "*Promille Rechnungen.*"

Book-keeping (2 hours per week).—Practice in the simple formulæ of accountancy, such as bills and invoices, economy and cash-book practice, taking inventories, discounts, accounts of societies, etc. Elaboration of easy examples for book-keeping by single entry.

Correspondence and Commercial Law (2 hours per week).—Practice in easy letter-writing and other matters in connection with the instruction in book-keeping. To be followed by commercial documents, for example, bills to order, notices of delivery, notice of acceptance, letters concerning payments, reclamations, etc. Advertisements, receipts, promissory notes, security obligations.

Geography (2 hours per week).—The physical and political geography of Switzerland, together with the other European countries.

History (2 hours per week).—Selected chapter from the modern history of Switzerland and the general history with special regard to the development of civilisation.

Writing and Stenography (4 hours per week).—German and French current handwriting. Round writing. Stenography: Stolze-Schrey system.

Singing (2 hours per week).—Classes III, II and I together. Practice in simple songs.

Class II.

German Language (4 hours per week).—Literary and realistic selections, and selections from politico-economic subjects. Treatment of one classic drama. Compositions and oral exercises in style.

German Commercial Correspondence (1 hour per week).—Easy letters concerning mercantile affairs and matters of exchange.

French Language (4 hours per week). Reading. Conversation. Oral reproductions. Examples of letters for introduction to commercial correspondence. Dictation. Free exercises.

English Language (Beginners, 4 hours per week). Etymology. Reading Written and oral translations. Dictation—Conversation.

Upper Division (4 hours per week).—Reading, translation, conversation. Grammar, with written exercises. Dictation. Free exercises. Memorising.

Italian Language (3 hours per week).—Grammar, with written exercises. Reading of short narratives. Oral reproduction of the same. Memorising of poems and short prose pieces. The elements of commercial correspondence.

Arithmetic (3 hours per week). Calculation of commercial profits. Calculation of percentages and "*Promille Rechnungen.*" Money, exchange, and discount calculations, calculation of simple shares, companies mixtures and merchandise. Various exercises in mental arithmetic.

Book-keeping (3 hours per week).—The more difficult formulæ of accountancy. Book-keeping by single entry. Preparatory exercises for book-keeping by double entry.

Commercial Law (1 hour per week).—Oral and written examination of "Jakob and Spreng's Geschäftsaufsätze."

Physics (2 hours per week).—The fundamental principles of chemistry. Air, water, coal, sulphur and phosphorus, acids. Bases and salts; cellulose; starch-flour, sugar, fat, soap, resin, alcohol, colouring matter. Application of chemistry to nutrition and hygiene.

History (2 hours per week).—History of Switzerland of the 19th century. Some sections from the history of Trade and Commerce from the time of discovery.

Geography (2 hours per week).—Commercial and trade geography of Switzerland.

Writing and Stenography (4 hours per week).—Stenography of Stolze-Schrey. German and English current handwriting. Round-hand. Type-writing.

Singing (2 hours per week).—Together with Classes III and I.

Needlework (3 hours per week).—Sample-patterns: Chemisette. A child's jacket or short coat, pinafore, aprons. Development of one of these. The application of embroidery to practical objects, for example, *linen sachets, etc.*

The aim of the instruction, which is imparted in the French language, is to confer on those pupils who are daily engaged in lingerie, confection, or embroidery work for sale purposes, the requisite knowledge and ideas for their efficient performance.

Class I

Class I.

German (2 hours per week).—Treatment of several classical and modern works. Exercises in oral expressions. Essays.

German Commercial Correspondence (2 hours per week).—Letters relating to merchandise, exchange, banking, and despatch business. Soliciting.

French (4 hours per week).—2 hours commercial correspondence: Round writing, offer of employment, inquiries, publication of intelligence, closing of accounts, letters of advice, etc. 2 hours—Reading, conversation, exercises in oral and written expression.

English—

Lower Division (4 hours per week).—Oral and written commercial correspondence; short essays, readings, conversational exercises (optional).

Upper Division (4 hours per week).—Commercial correspondence, written and oral translations and free exercises. Extra courses in the articles of commerce and historical literary themes. Reading. Memorising.

Italian (3 hours per week).—Grammar. Written exercises. Reading and explanation of selections from the various classics. Conversational exercises. Mercantile letters.

Arithmetic (3 hours per week).—The more difficult examples of interest and discount, calculations of rate, stock accounts, calculations of gold and silver; invoices. The usual forms of the "*Bank-Conto-corrents*." Exercises in mental arithmetic. Recapitulation.

Book-keeping (3 hours per week).—Book-keeping by double entry, according to the American, Italian and German systems. Discussion of irregular instances of book-keeping.

Knowledge of Merchandise (1 hour per week).—The most important merchandise of plant and animal and mineral origin.

Commercial Law (2 hours per week).—The most important sections of the Swiss law of obligations. Bankruptcy and meeting of creditors. The stamp law of Berne.

Political Economy (2 hours per week).—The fundamental principles of political economy. The formation and production of economic wealth. Wealth in human society. Mission of the State in the promotion of the common weal of the community.

Geography (2 hours per week).—Discussion of the countries of Europe, and the most important civilised countries outside Europe. Voyages of discoveries, colonisation. The ocean in its importance for climate, production, and commerce. The specification of Swiss commerce for foreign countries.

Bureau (3 hours per week).—Type-writing. Multiplication (carbon-copies). Extended practice in current and round writing and stenography. Discussion and despatch of bills of lading, declarations, mandates, and other commercial documents.

Singing (1 hour per week).—Combined with Classes III and II.

5. *History of the Berne Commercial School for Young Women.*—The growing need, arising from the social and political changes that are taking place in our community, for some corresponding educational change, suggests a reference to the history of commercial education for women in Switzerland

The Berne school, established in 1876, was the first in Switzerland, and until 1891, with the exception of the commercial classes opened in 1881 in the Girls' Secondary School at Biel (Bienne), it was the only one in Switzerland. The course began with twelve scholars, but from year to year the numbers increased, so that after four years about thirty attended the then one-year courses. In 1892 a second year's course was added, and the curriculum revised. The attendance still further increasing necessitated the establishment of parallel classes for the lower and upper courses in 1895. Four years later there were ninety scholars in four classes.

The steady progress led, in December, 1900, to the Municipality approving of the addition of a third year's course, which was to have been substantially arranged as a preparatory course for such scholars as were unable to complete their studies at a more classical secondary school, or those whose health would not permit them to enter straightway on the severer course of studies.

The advantages obtained are conspicuous, and pupils possessing the diploma often begin with a salary far in advance of what they would otherwise receive; in fact, good positions are open at once to all students with the diploma. A good acquaintance with a correct management of a mercantile establishment, as regards accounts and book-keeping; a knowledge of the elements of the theory of commerce and exchange; versatility in correspondence in at least two languages, in stenography, type-writing, and in the multiplication (of copies), are qualifications which, added to a good linguistic knowledge of geography, make the services of the possessor immediately valuable. Many proprietors of firms apply direct to the school for additions to their staff of employees, and the school is thus able to secure good positions for its pupils.

These facts have impressed the Bernese with the value of the work undertaken.

6. *Commercial School in the Municipal Gymnasium, Berne.*—The municipal authorities of Berne have recognised the importance of commercial education for boys in the four years' course in the Municipal Gymnasium. The "*Handelsschule des städtischen Gymnasiums in Bern*" is really a subdivision of the Gymnasium with four classes of one year each. It aims at giving good general instruction to the pupils while it also thoroughly prepares them for their future career.

The *entrance-conditions* are that the pupils should be 14 years of age and have passed successfully through the classes of a good "secondary" school.[1]

Foreign pupils ought to possess sufficient knowledge of German language to enable them to follow the lessons.

Instruction in gymnastics is obligatory, in swimming optional.

The school-year begins about the middle of April. The annual fee is 60 frs. (£2 8s.); the inscription-fee, 5 frs. (4s.); on promotion to a higher class the pupil pays 2 frs. (1s. 7d.). To regular pupils in poor circumstances the instruction is gratuitous. The Canton grants bursaries from the III Class onward, the Swiss Confederation from the II Class onward.

During the summer vacations, the most deserving pupils are permitted to participate in educative excursions under the guidance of the masters; the expenses of these are defrayed by the State, the Confederation, and the interest of a special fund.

The pupils also visit annually, under the direction of the masters, the various industrial institutions.

At the end of the fourth year a maturity examination[2] is held. The possession of the *certificate*,[3] awarded to those successful at this examination, is very important in respect of subsequent educational progress.

The Gymnasium is not a boarding school.[4]

7.

[1] The *école secondaire* and the *Sekundarschule* of some parts of Switzerland is the next higher grade to primary education. See Chapter XXVII, pp. 315–334, in particular 316, of the Commissioners' Report on Secondary Education.

[2] "*Maturitätsexamen*"; in French "*examen de maturité*."

[3] "*Reifezeugnis*" or "*Diplom*"; in French "*certificat de capacité*" or "*diplôme*."

[4] Foreign pupils board in the city.

7. *General Programme.*—The four years' course is conducted according to the following programme, viz.:—

Programme of the "Handelsschule (Commercial School) des Städtischen Gymnasium in Bern."

Subjects.	Years and Hours per Week.			
	IV.	III.	II.	I.
Religion (optional) ...	(1)	...	1	...
German ...	4	3	3	3
French ...	4	3	3	3
English ...	3	3	3	2
Italian ...	3	3	3	2
Mathematics and Political Arithmetic ...	2	2	2	2
Commercial Arithmetic ...	3	3	3	...
Accountancy and Counting-house practice ...	...	3	3	3
Theory of Commerce and Commercial Law ...	...	2	3	2
Political Economy ...	...	...	...	3
Geography and Statistics ...	2	2	2	2
History ...	2	2	2	2
Natural Sciences ...	2	2	...	...
Physics ...	2	2	...	...
Chemistry, Technology, Study of Merchandise ...	...	...	3	4
Drawing ...	2	2	2	2
Caligraphy and Stenography ...	3	1	...	...
Gymnastics ...	2	2	2	2
Singing (optional) ...	...	(1)	(1)	...
Total of obligatory lessons ...	34	35	34	32
Total of all the lessons... ...	35	36	35	32

8. *Details, Commercial School, Berne.*—The details, which give a general idea of the course, are set forth hereunder. The work is set out class for class, the ages (minimum) being—

IV.	III.	II.	I.	Class.
14	15	16	17	Years.

Details of the Programme in the Four Classes or Years.

Class IV (Lower Class).

Religion (1 hour)—(For Protestants only, and optional).—History of the Church.

German (4 hours).—Supplementary recapitulation of difficult parts of grammar. Study of scansion in the selections read. Interpretation of selections of prose and poetry. Compositions. Letters. Oral expositions.

French (4 hours).—Syntax. Translations. Commercial letters. Compositions. Conversation. Recitations. Reproductions. Reading.

English (3 hours).—Syntax. Easy translations and versions.

Italian (3 hours).—Grammar with exercises. Reading and translation of selections of easy prose. Recitations.

Mathematics (2 hours):—

(*a*) *Algebra.*—Easy equations of the first degree to several unknowns. Simple equations of the second degree. Elementary knowledge of powers and roots.

(*b*) *Geometry.*—Conclusion of planimetry, especially the computation of surfaces. Elements of stereometry; surface, volume, and weights of bodies.

Commercial Arithmetic (3 hours).—Abbreviations of calculations. The principal coins, weights, and measures. Reductions. Accounts of purchases. Account sales. Conjoined rule. Proportional parts. Rule of mixtures and alligation. Different uses of the calculation of percentage. Calculation of interest according to various methods. Compound interest. Mean maturity. Mental arithmetic.

Geography (2 hours).—Elements of mathematical and physical geography. Geography of the countries situated outside Europe, with special study of the population, products, and the commercial movement.

History (2 hours).—Contemporary history of Switzerland. The Federal Constitution.

Natural Science (2 hours):—

(*a*) In *Summer.*—The Linnean system. Study of some families of plants. Exercises in the classification of the most ordinary phanerogams.

(*b*) In *Winter.*—The vertebrates as a sequel to the course of the first class of the lower gymnasium.

Physics (2 hours).—The principal ideas concerning solid, liquid, and gaseous substances. Magnetism and electricity.

Drawing (2 hours).—Drawing from perspective, with or without shading; ornamental drawing. Sketching exercises.

Caligraphy and Stenography (3 hours).—Exercises in German, English, and round writing. Commercial formulæ. Stenography.

Class III.

German (3 hours).—Reading of prose and poetic selections. Elements of poetry. Ideas concerning rhetoric and style. Written studies: compositions, letters. Oral expositions.

French (3 hours).—Syntax. Translations. Business letters. Compositions. Recitations. Reading. Conversation. Oral expositions.

English (3 hours).—Continuation of the syntax. Exercises in oral and written translation. Reading selections taken from the principal authors. Conversation. Recitations. The instruction is given largely in the English language itself.[1]

Italian (3 hours).—Irregular verbs. Syntax. Reading, translation, and reproduction of prose selections. Recitations. Conversation. The instruction is given, as far as possible, in Italian.

Mathematics (2 hours):—

(*a*) *Algebra.*—Logarithms. Calculation of compound interest. Geometric series.

(*b*) *Geometry.*—Continuation of planimetry and stereometry. Plan and design of ground.

Commercial Arithmetic (4 hours).—Discount. Exchange. Calculation of exchanges according to the principal quotations. Invoices; net cost and sale limit.

Accountancy

[1] Wherever this was seen it was well done.

Accountancy and Counting-house Practice (3 hours) :—

(*a*) Book-keeping in single and double entry. Exercises in the Italian and German methods. Current accounts according to the various methods.

(*b*) The various operations of the counting-house.

Theory of Commerce and Commercial Law (2 hours).—Commerce and its various kinds. Commercial register; the merchant; trading companies and firms; the personnel of the bureaux. Coin and paper money. Paper credit. The Latin Union. Elements of a bill of exchange.

Geography (2 hours).—Switzerland, Germany, France, Italy, Belgium, Holland, and England, with the colonies of these countries. Study of them from the standpoint of their commercial position, their soil and products. Railways and navigation.

History (2 hours).—Universal history; history of the Middle Ages and modern history to the French Revolution inclusively.

Natural Science (2 hours) :—

(*a*) In Summer.—Study of other families of plants according to the natural system; indigenous and exotic plants; more complete study of phanerogams.

(*b*) In Winter.—The principal types of invertebrates, especially from the point of view of the useful or noxious species.

Physics (2 hours).—Acoustics, optics, and heat.

Drawing (2 hours).—Drawing of ornaments, animals, etc., from figures.

Stenography (1 hour).—Continuation of the course of Class IV

Class II.

German (3 hours).—Aperçu of literary history. The classics, with reading and interpretation of selections. Compositions with special regard to reading. Oral expositions.

French (3 hours).—Commercial letters. Translations. Compositions. Oral expositions. Literature; the principal authors of the 17th century, with reading of selections. Home reading.

English (3 hours).—Continuation of the programme of class III. Short compositions and commercial letters. The lessons are given in English.

Italian (3 hours).—Reading of one or several modern prose works. Translations. Commercial letters. Recitations. Conversation. The lessons are given in Italian.

Mathematics (2 hours).—Calculations of loans, of annuities, amortisements, and rentes.

Commercial Arithmetic (3 hours).—The precious metals and coins. The net cost and parities in merchandise. Calculations of exchange: indirect exchange, commission and arbitration. Bourse operations: shares, obligations, public funds.

Book-keeping and Counting-house practice (3 hours) :—

(*a*) Other forms of book-keeping by double entry—for example, the American method. Progress of commerce, with all the auxiliary books. Account current at variable and invariable rates. Special accounts of commercial enterprises. Companies under collective name and joint-stock companies. Partnerships.

(*b*) The various operations of the counting-house.

Theory of Commerce and Commercial Law (3 hours).—Continuation of the study of the bill of exchange compared with that of foreign countries. Other fiduciary values: paper money, bank-notes, mandate, cheques, drafts, warrants, obligations, shares, etc. Trading companies, according to the federal code of obligations. Custom duties and commercial treaties.

Geography (2 hours).—Austria-Hungary. The Balkan States. Russia. The States of Scandinavia. Spain and Portugal (with their colonies). The United States, Mexico, Brazil, the Argentine Republic, Chili, China, Japan, etc. These different states are treated from the same point of view as in class III. Postal steam navigation, cables, Universal Postal Union.

History (2 hours).—History of commerce.

Chemistry and Technology (2 hours).—Principles of chemistry, and their employment in practice.

Drawing (2 hours).—Ornaments presenting certain difficulties of execution; simple academic studies from figures.

Class I.

German (3 hours).—Contemporary literary history; special study of the literature of German Switzerland; reading of selections from the authors treated. Oral explanations and compositions as in class II.

French (3 hours).—Commercial correspondence. Translations. Compositions on subjects selected by the pupils or on their particular readings. Literature: the principal authors of the 18th and 19th centuries, with readings. Home readings. The instruction in all the classes is given in French.

English (2 hours)—Recapitulation. The instruction of the preceding years is developed and completed by the study of more difficult parts. English literature in its principal representatives since Shakespeare. Recitations. The instruction is given in English.

Italian (2 hours).—Aperçu of Italian literature to the 18th and 19th centuries, with reading of selections of the corresponding authors. Compositions. Exercises in Italian commercial correspondence. Oral explanations. The instruction is given in Italian.

Mathematics (2 hours).—Continuation of political arithmetic commenced in Class II. Calculation of probabilities. Insurances.

Book-keeping (3 hours) :—

(*a*) Book-keeping in banks and industrial accountancy. Particular examples of book-keeping. Theory of book-keeping by double entry. Other systems of accountancy.

(*b*) Commercial correspondence.

Theory of Commerce and Commercial Law (2 hours).—General principles of law. The federal code of obligations. The contract in general and the principal commercial contracts in particular—for example, the sale, on return, etc. The main parts of the federal laws concerning prosecution for debts and bankruptcy, the protection of manufactories, the responsibility of patrons, insurances, patents, custom duties, carriage, etc.

Political Economy (3 hours).—Fundamental ideas. Production and distribution of wealth: salaries, interest, revenue of contractors, annuity. Circulation of wealth. Free-trade and Protection. Price. Silver and various monetary systems. Credit. Banks. Custom duties and commercial treaties. The medium of transport. Crises. Assurances Historic glance.

Statistics (2 hours).—Population, production, consumption, and commercial movement from the standpoint of statistics.

History (3 hours).—Contemporaneous history, from the Vienna Congress.

Chemistry, Technology, study of Merchandise (4 hours).—The principal commercial products. Colonial commodities and drugs. Aliments and consumption of luxuries. Textile and dyeing substances; their production and preparation.

Drawing (2 hours).—Theory of forms and artistic ornamentation.

Other Subjects of Instruction.

Gymnastics (2 hours in each class).

Gymnastic Performances.—Free exercises, and exercises with apparatus. Sabre exercise.

Singing (Optional Course).—One hour in classes III and II.

Swimming (Optional Course).—One hour per day in Summer.

The above course is appreciated by commercial men in Berne and Switzerland generally. The Committee of the Commercial and Industrial Society of the canton recommend attendance at this to all youths who are desirous of devoting themselves to Commerce, to Administration, to the various branches of transport, or to commercial teaching.

It is obvious that the course may be regarded as that of a Secondary Commercial School, not, however, that of a Commercial University.

9. *Commercial Section of a Genevese Secondary School for Girls.*—Many Swiss schools have Commercial Sections. The following one is a subdivision[1] of an "*Ecole secondaire et supérieure des jeunes filles à Genève.*" The fees are 30 fr. (£1 4s.) per semester (half-year). The school receives, without preliminary examination, pupils provided with a Leaving Certificate of Class V of the Girls' Secondary and Higher School, of the Domestic Economy and Professional Schools of Geneva, of Carouge, and of the secondary rural schools.

The candidates who do not possess this certificate should be at least 15 years of age and undergo an examination in the following subjects, viz.:—

(*a*) *French.*—Dictation. Exercises in correspondence.
(*b*) *Arithmetic.*—Problems on the metric system, vulgar fractions, proportion.
(*c*) *Geography.*—Ideas concerning the five continents.
(*d*) *German.*—Translation of a passage. Regular and irregular verbs.

The programme is as follows:—

Programme, " Section Commerciale, Ecole secondaire et supérieure des jeunes filles à Genève."

Subjects.	Years and Hours per Week.		
	I.	II.	III.
French	4	4	2
German	4	4	3
English	4	4	3
Commercial Arithmetic, Book-keeping, Commercial Bureau ...	7	7	7[2]
Merchandise	...	3	2
Commercial Geography	2	2	2
Law	1	2	1
Physics	2	...	...
Drawing	2	...	...
Caligraphy	2	...	...
Needlework	2	2	...
Stenography	2	2	...
Stenography and Type-writing (winter semester)	...	...	3
Totals	32	32	23 in winter. 20 in summer.

There is a course in French for foreign students, as follows:—

Special Teaching in French—For non-French Students. (Two divisions.)

Dialogues on various subjects	2 hours.	Literature	2 hours.
Illustrated readings, redactions ...	2 "	Natural Science (optional)	1 "
Grammar...	2 "	Geography (optional)	1 "
Dictations, with comments on the rules studied...	2 "	History (optional)	1 "
Recitation or Elocution...	2 "	Total (including 3 optional hours)	15 hours.

The school-year is from forty to forty-two weeks in length, at the rate of thirty-two hours per week, but for the third year the hours are twenty to twenty-three per week.

The home-work may be substituted by an hour's recapitulation, which takes place five times a week and which is solely devoted to practical exercises on the subjects taught.

The regular pupils, whose careers at the school have been most successful, receive, on leaving, a Diploma.

10. *Details of Courses, Commercial Section of Girls' Higher School, Geneva.*—It will suffice to quote one or two subjects. It may be mentioned that the language-teaching is commercially orientated. For example, in French the instruction includes dialogues and oral and written narrations on subjects relative to industry and commerce, in which there is some insistance on the significance and orthography of technical terms. Commercial letters on simple subjects also form a feature of the instruction.

In English, etc., the intuitive method is followed and the pupil learns to express herself in the language in a very short time.

Law is treated as follows:—

First Year (1 hour per week).—General ideas with regard to law, common law, present legislation in Switzerland. Elements of civil law: Nationality, the *état—civil*, domicile, absence, minority, and majority. Civil capacity: Tutelage, emancipation, adoption, marriage, juridical status of the woman. Successions, donations and testaments. Division of goods: Property and the actual rights.

Second Year (2 hours per week).—Obligations, contracts, their form, proof of agreements, consequences of the failure of the fulfilment of obligations. Principal contracts, sale, rent-lease, hiring of services, hiring of labour, loan, civil and commercial mandate, commission, transport, deposit, security. Companies: simple, in collective name, limited joint-stock company, joint-stock. Law of exchange: treaty, bill of exchange, cheque. Register of commerce. Rapid study of the federal laws with respect to prosecution for debts and bankruptcy, manufacturer's marks, designs and models, manufacturers and patents.

Third Year (1 hour per week).—General review of commercial law. Commerce and merchants. Acts of commerce; principal litigious and contentious questions. Practical exercises applied to the commercial bureau.

The

[1] The other sections of the school are the literary and pædagogic. [2] Commercial Bureau in particular.

The course in technology and merchandise is taken in the second and third years as follows :—

Second Year.—General ideas with regard to raw materials. Sugars in general. Sacchariferous plants. Sugar-cane. Beet-root. Extraction of sugar, diffusion, carbonising, refining. Commercial types. Glucose. Industrial manufacture; sugar of milk. Honey. Saccharine. Spirituous liquors, beer, wine, cider, etc.

Alcohols. Alcohol of wine, alcohol of industry. Commerce, denaturing.

Milk and its derivatives. Beer, margarine. Cheese. Fatty bodies and their industrial products. The soap industry. Essential oils.

Waxy, gummy, resinous and oleo-resinous matters. Amber and celluloid.

Inspissated juices. Caoutchoucs, gutta-percha, their industrial applications.

Colonial commodities. Cocoas and chocolate, coffees, teas, and their succedanea.

Feculent substances. The flour-mill industry, alimentary and commercial value of cereals. Panification. Eggs, meats, fish.

Tegumentary and skeleton animal matters. Skins, hairs, furs, horns, shells, ivory, bone. Tanning, currying, leather-dressing.

The professor prepares a museum of specimens, each of which is circulated during the lessons, in illustration of his teaching.

Third Year (3 hours per week).—Textile matters. General characters, chemical composition, condition, comparative examination of the various fibres. Wool; a general glance at the woollen industry. Regenerated wools. Cashmere, angora, alpaca wools, etc. Silk : "*Magnanaries,*" produce, diseases of silk-worms. Winding, spinning, etc., utilisation of waste. The silk industry in various sericultural countries. Artificial silk, its manufacture, its future, etc. Cotton, its commercial importance, industry, carding, combing, rolling. Spinning properly speaking. Flax : its preparation, retting, stripping, scraping, blanching. Spinning and weaving of flax, history. Hemp, ramie, jute, alfa, coir, etc. Industry of preparations, dyeing, printing, mordants. The paper industry : its manufacture with rags and their succedanea. Some facts regarding "*papiers de sûreté*" and machine-papers.

The colouring matters employed in the textile or other industries. Their origin, their extraction, comparative commercial value.

Natural and artificial coubustibles.—Coal, lignite, turf, etc. Petroleum. Illumination gas and manufactured residues. Acetylene. Asphalts and bitumens.

Precious and common metals. Minerals, extraction, metallurgy, and principal industrial alloys. Precious stones.

It has been mentioned that specialism in higher teaching is a feature of European teaching. In this connection it may be mentioned that there are eighteen women teachers (*maîtresses d'études*) and thirty-eight special masters (and mistresses) for ordinary subjects, and three for optional subjects. There are also five instructors in religion.

11. *The Higher School of Commerce, Geneva.*—The aim of this school is to afford an education for clerks, merchants, administrators, such that they will be able not only to efficiently direct local commerce, but also to develope the commercial and industrial relations of Geneva and Switzerland with foreign countries.

The course complete lasts three years.

The first year is designed for those whose limitations in the way of general or special knowledge would prevent them from profiting by the more advanced instruction of the two ensuing years; that is to say, it is essentially preparatory.

In the two latter years an extensive knowledge of all that concerns commercial science may be acquired.

The annual school-fee is 50 fr. (£2), payable quarterly and in advance for each of the three divisions, for Genevese and Swiss pupils generally. Foreign pupils, whose parents have resided in Geneva for at least ten years, pay the same; but foreigners who do not fulfil this condition pay 200 fr. (£8).[1]

Each of the three divisions receives as many irregular students as the number of regular pupils will permit without crowding.

The irregular students are subject to the same disciplinary rules as the regular pupils. They should show proof of their ability to follow the courses they have selected.

The fee per hour of course is 5 fr. (4s.) for the entire year for the Genevese and Swiss pupils, and 10 fr. (8s.) for foreigners.

The following facts may be of interest, as shewing the working capacity of European youths.

The school year is from forty to forty-two weeks, at the minimum rate of thirty-three hours per week. It is divided into two semesters; the first extending from September to the end of January, the second from February to the end of June.

The lessons begin in summer at 7 *o'clock in the morning, in winter at* 8 *o'clock*, and in the afternoon at 2 o'clock throughout the entire year.

The winter horary begins on the first Monday of October, and the summer horary on the first Monday in April.

Pupils may be obliged to attend courses on industrial or commercial subjects given by others than the regular teaching staff.

There is an interval of ten minutes between all the lessons where there is a change of professor.

The summer vacation begins on the day of the presentation of the diplomas, and lasts for eight weeks. There is also a week at the New Year, three days at the end of the first semester, and one week at Easter.

12. *General régime, Geneva Higher School of Commerce.*—Pupils are admitted by examination, and must be 15 years of age. Their attainments must be equal to the fifth class of the college or second class of the professional school.[2] The following items of information are translated or derived from the official prospectus, and are of interest as shewing the ideas of other countries as to a scheme of examination, etc.

Examinations.

The Administrative Council, on the recommendation of the *Commission de Surveillance* or Director, appreciates the value of the *certificats d'études* proceeding from other national or foreign public institutions. The inspection of these being satisfactory, a pupil may be partially or totally exempted from the entrance examinations.

In order to be admitted, a candidate must obtain at least the half of the maximum on all the subjects, not to have had lower marks than 20 per cent. for two subjects at most, nor the mark 0 per cent. for any; but he may be re-examined in January in every subject for which he has not previously obtained a higher mark than 3. If he fails in January, he passes to the lowest division, or is excluded from the school if it should be his first year there. A pupil may be admitted conditionally only at the beginning of the school-year.

A

[1] Even this is a small fee. [2] See the Commissioners' Interim Report on Primary Education, Chap. V, pp. 34–5.

A pupil whose examination marks have not satisfied the examiners may only be admitted to the lowest class if the *Commission de Surveillance* or its delegates, on the inspection of the test that he has just undergone, and on the recommendation of the professors, consent to his admission.

Promotion from one division to another depends on the results of the examinations, *combined with the year's work.*

In addition to the written tests and the interrogations, pupils undergo semi-annual examinations on the instruction they have received.

The examinations are written and oral, the *Commission de Surveillance* deciding as to the method to be adopted for each subject.

For the half-yearly examinations the Administrative Council nominates, on the recommendation of the *Commission de Surveillance*, a Board of Examiners for each branch, the same Board of Examiners dealing with the same branch for the three divisions.

For the written examination, the Board sets the questions in conjunction with the professor. The professor corrects the papers, and submits them, together with his estimations of them, to the judgment of the Board. In the event of disagreement, the *Commission de Surveillance*, or a delegation therefrom, judges in the last resort.

In the oral examination, the *professor* conducts the interrogation. The questions are drawn by lots by the pupils. A pupil may request to draw a second question, but he thus loses a third of the marks to which he would otherwise be entitled.

Every pupil who has failed in no more than two subjects may be re-examined therein on the reopening of the classes. These supplementary examinations are conducted by the professors of the division where the pupil is desirous of entering.

If a pupil fail in any subject whatsoever when the second time examined, he is debarred from further attendance.

The *Commission de Surveillance* may, on the recommendation of the conference of professors and for serious reasons, postpone the examination of a pupil until the reopening of the classes. The pupils whose examinations have been postponed in a disciplinary way are, if unsuccessful, not allowed further opportunity.

A verbal communication with a neighbour during a written examination cancels the examination for the subject in question. Any cheating or attempt thereat cancels the entire examination.

Diplomas.—50 per cent. entitles to a first-class diploma. This holds for conduct and passing in subjects. Above 40 per cent. entitles to a second-class diploma. Pupils who do not receive a diploma receive an attestation of attendance.

13. *Programme, Higher School of Commerce, Geneva.*—The programme of work hereunder is, of course, technically orientated. It will be observed that it is not at all similar to the programme for young women.

"*Programme de l'école supérieure de Commerce à Genève,*" *Switzerland.*

Subjects.	Years—Hours per week.		
	I.	II.	III.
French	4	3	3
German	5	4	4
English, Italian, Spanish (optional)	4	4	4
Caligraphy	3	2	...
Book-keeping	4	...	...
Mathematics (Arithmetic, Algebra, Geometry)	5	3	3
Geography	2	2	2
History	2	2	...
Physics	2	...	...
Chemistry	2	...	...
Civil Law	...	2	...
Commercial Law and Political Economy	...	3	4
Study of negotiable products	...	3	3
Commercial Bureau	...	6	8
Stenography and Type-writing	...	...	2
Microscope	...	...	2
Lectures by Pupils to their Fellow-pupils—Year III (every Saturday)	...	...	?
Visits to Factories	?	?	?
Totals	33	34	35

14. *Details of Courses, Geneva Commercial School.*—It is unnecessary to outline the complete courses. Reference to special subjects, or to special features in the treatment of subjects, will be adequate.

Languages.

French, first year, includes oral and written narrations on subjects relating to industry and commerce, the study of technical terms, forms of accounts rendered, and commercial letters on easy subjects. Second-year work includes reading and elocutionary lessons on subjects relating to commerce and industry. It also includes commercial correspondence and purely literary work, such as involves exercises in invention, comparison, association, style, the study of terms and correction of defective expressions. Third-year work is largely literary.

German, first year, includes, among other things, the phraseology and terminology in vogue in correspondence, and the reading and translation of commercial letters. In the second year it includes Gallicisms and Germanisms, reading and conversational exercises, the terminology of the principal articles of commerce, the phraseology of commercial letters, and instruction concerning the commerce of Germany. In the third-year work, *the instruction is wholly given in the language.* It refers to the commerce of Germany, the customs and the laws recently established, to German literature, and specially to the five great classics; and reading and interpretation of some of their masterpieces is undertaken.

English is treated much on the same principles; conversation is commenced at once. Second-year work reaches the study of commercial terms. Third-year work is given wholly in English itself.

 Italian

Italian.—The first-year work is purely literary and conversational; the third year includes commercial correspondence, the reading of the classics, composition, an aperçu of the history of Italian literature, from Dante to Manzoni, and an epitome of the history of Italian Independence, from 1848 to the death of King Victor Emanuel.

Spanish.—The third-year instruction is given wholly in Spanish itself.

Caligraphy.—The instruction in writing embraces the study of English writing (large, medium, and fine) from graduated models. There are special exercises for rendering the hand flexible, and a study of a fluent, large, medium, and fine writing on ruled and unruled paper. The form of exercises embraces letters, envelopes, circulars, commercial formulæ, figures in columns, with or without ruling. Various kinds of ruling for accounts, balance-sheets, invoices, etc. Bâtarde is taken the second year. The addressing of packages by means of a wooden pen, and a number of practical exercises, are given.

Accountancy and Book-keeping.—The course is developed as follows:—

First Year (4 hours per week).—Bills of exchange, letters of exchange, cheque, warrant, guaranty, bill, remittance, etc. Invoices. Debit and credit. Debtor and creditor. Receipts and disbursements. Assets and liabilities. Definition of book-keeping. Double entry. Principal books: Waste-book, cash-book, day-book, stock-book, current accounts (*débiteur*) ledger.

Auxiliary books: For the copies of letters, bills, etc.

Opening of books: Single individual; partners in a collective name without sleeping partner; partners in a collective name with one or several sleeping partners; a limited joint stock company. Joint stock companies generally.

General accounts: Of the merchant, negotiable values, of correspondents.

Balance of accounts current checked by the general account which represents them in the ledger.

Commission accounts. Joint accounts. Rectification of errors. Auditing. Inventory and balance-sheet. Closing and reopening accounts.

Application: Book-keeping, double entry.

Mathematics.—The following is the programme of the first year:—

Arithmetic.—Calculation of interest by the practical methods usual in commerce. Method of fixed divisors; methods of fixed multipliers; method of aliquot parts, etc. Calculation of percentages. Calculation of net costs. Discounts on invoices, on commercial bills. Mean maturity. Proportional shares. Mixture and alligation. Accounts current (direct and indirect methods).

Mental Calculation.—Exercises bearing on the above programme.

Algebra.—Easy problems for the purpose of disclosing the advantages of the algebraic method. The four fundamental operations on the algebraic expressions in simple cases. Equations of the first degree to one and several unknowns. Extraction of the square root of numerical quantities (practical method). Resolution of the equation of the second degree.

Geometry—

(I) Principal properties of angles and triangles. Properties of perpendiculars and obliques. Theory of parallel lines. Properties of the circle. Calculation of surfaces. Similar figures and their principle properties. Problems of construction.

(II) Principal properties of perpendicular and oblique lines on a plane. Measure of the dihedral angle. Measure of the surface and volume of the parallelipiped rectangle and prism. Measure of the surface and volume of the pyramid, cone, cylinder, and sphere. Numerous applications.

The second-year work is a practical application of mathematics to commercial problems of a general character, and to simpler questions of accountancy.

The third-year work is as follows:—

Numerous exercises of recapitulation on the programmes of the preceding years. Logarithms; use of tables. Questions of compound interest, of annual investments, of annuities. Applications to the questions of loan, of amortisation. Different kinds of loans, of amortisations. Tables of mortality. Life annuities. Insurances in cases of death. Mixed insurances, insurances at a fixed term. Fixing of tariffs. Use of tables relating to these various questions.

Geography is studied from the liberal, historical, industrial, and practical commercial standpoints, and is world-wide in its range. It may be mentioned here that the Commissioners had disclosed to them the thoroughness of the knowledge of geography in the Swiss commercial schools in a very impressive way.[1]

History (Years I, II) is industrially and commercially orientated, but in a liberal way, as the following programme will shew:—

First Year.—A glance at the commerce of antiquity. Elementary ideas of commerce among primitive peoples. The Phœnicians and Arabs. The Carthaginians. The Greeks and Romans.

The invasion of Barbarians and the formation of the Gothic kingdoms in Europe.

The Byzantine Empire. The Arabs of Asia and Spain. Western Europe before and after Charlemagne; Feudalism; the Crusades. The Italian Republic; Amalfi, Pisa, Venice, Genoa, Florence. The Flemish cities; organisation, trade, commerce and industry. The Hanseatic League and the cities of the south of Germany. Barcelona.

France in the 14th and 15th centuries: the markets, letters of exchange, banks. The Portuguese. Voyages and discoveries of the 15th century. Discovery of America.

A rapid glance at the historic and economic development of the European States and their colonies from the 16th century until the present time.

Second Year.—Formation of the States of modern Europe. The Renaissance and the Reformation. The Portuguese and Spanish colonies. The United Provinces and their colonies. Economic development of England from the reign of Elizabeth to the reign of George III. France from the reign of Henry IV to the reign of Louis XIV. Sully and Colbert's Administration. The English colonies of America; The War of Independence. The East Indies Company. Struggle of England and France for naval supremacy. The 18th century in France and the French Revolution. Northern Europe in the 18th century: Scandinavia, Russia, Germany.

Europe in the 19th century:—

France.—The Consulate and Empire, banks, commerce, industry; the Restoration; the reign of Louis Philippe, economic reforms and new colonies; the Empire, new colonies under the third Republic.

England.—Economic reforms under Canning and Robert Peel; progress of England in Asia and Africa.

Germany.—The Zollverein; the political movements in Berlin and Vienna in 1848; wars with Denmark, Austria, and France; foundation of the German Empire; Germany's attempts at colonisation.

A glance at the trade of other parts of the world: England, America, Spanish America; recent explorations of the African continent; the Far-East and Oceania.

Physics

[1] See Preliminary Report of the Commissioners on Technical Education generally, 19 December, 1904, III, sec. 5, p. 15.

Physics and Chemistry are taken for one year only. The following is a sufficient indication of the course. The teaching equipments are very good. Each subject occupies two hours a week :—

Physics—

(i) *Gravity.*—Balances. Density. Hydrostatics.

(ii) *Heat.*—Dilatation. Thermometry. Calorimetry. Firing and ventilation. Steam engines and refrigerators. The sun. Hygrometry.

(iii) *Electricity*—

(*a*) *Static.*—Conductivity. The two electric states; electric machines. Influence. Condensers. Electricity in the atmosphere.

(*b*) *Dynamic.*—Electromotive force. Piles. Electrolysis.

(c) Magnetism. Magnets. Magnetic state of the globe. Electric Telegraphy. Telephone. Electric light. Electro-metallurgy. Galvanoplastics. Transmission of energy by electricity, cables for same. Lightning-conductors.

(iv) *Acoustics.*—General principles. The voice and hearing. Musical instruments.

(v) *Optics.*—Velocity of light. Undulatory theory. Reflexion. Refraction. Simple optical instruments. Prisms, the spectrum. Photography. Photo-lithography. Zincography.

Chemistry—

(i) *Generalities.*—Symbols. Formulæ. Nomenclature.

(ii) *Metalloids.*—Study of the principal metalloids and their combination.

(iii) *Metals.*—Study of the principal metals and their salts. Metallurgy.

Law, Commercial Law, Technology, and Merchandise call for no general comment. It may be mentioned, however, in regard to technology and commercial products, that the instructor prepares and introduces specimens illustrating his lectures, and projects microscopic preparations and micro- or industrial photographs on the screens.

Pupils are taught to examine merchandise; they test it under supervision, and use the microscope to ascertain adulterations.

15. *The Commercial Bureau, Geneva School of Commerce.*—The school is constituted as a Mercantile establishment performing each type of operation, with the bank, merchandise, etc., on its own account, on commission, on joint account, etc. The instruction covers such matters as buying orders, net cost, business arrangements or agreements, despatch of goods, etc.; bills of exchange, bills for settlement, for endorsement, bills of lading, warrants, insurances, outstanding debts, general and particular averages, loss by storm, fire, shipwreck, capture, etc.; balance-sheets, liquidation. Correspondence is in French and other languages. All transactions are regularly registered, and the books are kept in double-entry system.

Each pupil, in turn, occupies the various positions in the fictitious establishment, as principal or director, cashier, accountant, correspondent, warehouseman, etc., etc.

This represents the first year's work of six hours per week. In the second year, the transactions are made more complicated, and include transactions in public funds, in liquidations, accounts with foreign houses, arbitrations, American accountancy.

A study is made of various special matters—brokerage, commission, speculations, banking, and insurance. The class is divided into mercantile establishments, some having their fictitious headquarters in Switzerland and some in foreign lands, business correspondence and transactions proceeding between them.

16. *Chemical and Microscopical Laboratories, Geneva Commercial School.*—Two hours a week are devoted to work with the microscope and in the chemical and physical laboratory. The Commisioners saw the students at work, and it was evident that the course is well done.

The demonstrations illustrate the utility of the microscope for the verification of merchandise in respect of purity and adulteration. Descriptions of the simple and compound microscope and general rules for microscopical observations; for the preparation of slides; for making sections; in the technique of preserving and staining liquids, etc., are given and made by the professor.

Examinations of alimentary substances, from a chemical and microscopic point of view, are taken, including such substances as farinas, spices, spirituous liquors, wines, beers, spirits, vinegars, oils, milk, meats and products of the pork-butcher, with regard to leprosy, trichinosis, etc., are undertaken. Verifications of ivory and of the various animal and vegetable products substituted for it are made. The fibres of cotton, wool, silk, flax, hemp, jute, ramie, are recognised, and their proportion in the textile fabrics are determined. Analyses of papers, of tapestries, of forged handwriting, are made. Culinary material, varnishes, oil-cloths, etc., are examined and animal and vegetable colouring-matters tested. Colorimetry, the analysis of tobaccos, the origin and quality of the hair employed in hat-making and the fur trade, and similar matters, engage the attention of pupils.

The laboratory is fitted with the most recent apparatus in vogue in industrial laboratories for the examination of raw and manufactured materials.

17. *Students' Lectures, Geneva Commercial School.*—Each pupil, in succession, is required to expound before his colleagues, for an assigned length of time, a commercial question, decided upon beforehand by one of the professors, so that he may gain practice in giving clear and forcible public expression to his views. This work is very valuable educationally. There is a commercial as well as a general library at the disposal of the pupils.

18. *Visits to Manufactories.*—Under the guidance of the Director and several professors, the pupils often visit the works established in Geneva, Switzerland, and France. A list of these will give some idea of the extent and significance of such visits.

The visits of recent years include such as the following, viz.:—Paper factory, Bellegarde, France; the National Museum, the Escher-Wyss workshops, and the Weaving School at Zurich; the Arsenal, the Mint, etc., at Berne; Electrical Industry workshops at Sécheron; furnaces and foundries at Chonidez; Condensed-milk factory at Vevey; factory for enamelled-ware at Zug; factory for condensed-milk at Cham, Zug; Electrical factory at Montreux; Stucker's iron foundry at Carouge; the forges, Gerlafingen; silk-weaving, Schwarzenbach, at Adlisweil; cotton and wool spinning, etc, at Derendingen; paper factory at Solothurn; the Jura-Simplon works at Biel (Bienne); confectionery works, Degallier-Deshusses at Versoix; glass factory of Monthey; and many others, as lead factories, diamond-cutting workshops, refrigerating plants, mechanical workshops, chocolate factories, margarine factory, model dairies, etc., vaccinal institute, breweries, tobacco factories, etc., etc.

Such visits as these are educative and give point to the commercial instruction.

19. *Regulations of the Cantonal School of Commerce of Lausanne.*—The regulations of European schools are much more definite and exact than with us. This fact arises from the thoroughness with which all questions of organisation, as well as of curriculum, are studied. The inclusion in this report of one example will be sufficient. For that purpose the *Règlement* of 7th January, 1902, of the "*Ecole cantonale de Commerce à Lausanne*," in Switzerland, are translated. They are as follows :—

THE CANTONAL SCHOOL OF COMMERCE, LAUSANNE.

Chapter I.

Art. 1.—The aim of the Cantonal Commercial School is to prepare pupils for a commercial career and, until the opening of the Cantonal Technicum, also for an administrative career. (Law, art 42.)

Art. 2.—The School of Commerce comprises three years of study.

The Courses in administration are divided into two years. (Law, art. 44.)

Art. 3.—At the end of the third year, the pupils who have fulfilled the conditions pertaining to the regulations, obtain a diploma.

Art. 4.—The subjects of study are the following :—

The French, German, English, Italian, and Spanish languages ; History ; Civic Instruction ; Commercial Geography ; Commercial Arithmetic ; Algebra ; Book-keeping ; Physics ; Chemistry ; Knowledge of Merchandise ; Commercial Law ; Political Economy ; Caligraphy ; Stenography ; Dactylography (Type-writing).

Art. 5.—The Administrative Courses are the following :—

A. *General Branches*—
The three national languages ; English ; History ; Civic Instruction ; Geography ; Arithmetic ; Algebra ; Accountancy ; Physics ; Chemistry ; Caligraphy ; Drawing.

B. *Special Branches*—
The Postal Sections : Study of the Postal service.
Telegraphic and Telephonic Sections : Special course in Physics ; study of the service.
The Customs Section : Knowledge of merchandise ; study of regulations and tariffs.

Art. 6.—Other subjects of study than those stated in Articles 4 and 5 may be introduced by the decision of the State Council.

Chapter II.—Administration.

Art. 7.—The authorities charged with the administration of the school are :—

The Council of State ; The Department of Public Instruction and Public Worship ; The School Council ; The Conference of Masters ; and the Director.

Art. 8.—The School Council is composed of five members : the Director, a delegate of the Department, and three members nominated by the Council of State, for the term of four years.

The President of the Council is appointed by the Department.

Art. 9.—The Council is convened by the Department at the request of the Director or of one of the members of the Council.

Art. 10.—The School Council has the following powers :—

(*a*) To annually establish a budget scheme ;
(*b*) To give its advice concerning the curriculum ;
(*c*) To apportion the lessons among the masters ;
(*d*) To advise as to the selection of masters.

Art. 11.—The members of the Council may, whenever so disposed, visit the school and be present at the courses.

The Council directs as to the measures to be taken in order that the placing of deserving pupils may be facilitated. It serves as an intermediate agent between the merchants of the canton and the Commercial School in questions of apprenticeship.

Art. 12.—The Conference of Masters has the following privileges :—

(*a*) To study the questions submitted to it by the Department, the Director, or by one of the members of the teaching personnel ; instruction, programmes, methods, manuals, discipline, etc.

Questions of study may be referred to committees appointed by the Conference or the Director, who is a member, *ex officio*.

(*b*) To determine the conduct-mark of pupils for the quarterly reports ;
(*c*) To give its decision concerning the admission of pupils ;
(*d*) To advise the Department as to the granting or refusing of promotions.

Art. 13.—The Director presides at the Conference ; he convenes it whenever he considers it necessary ; he is obliged to do so within a fortnight of the express request of one or several members of the teaching-personnel.

The masters should attend the meetings of the Conference.

Art. 14.—At the beginning of each school-year, the Conference appoints from among its members a vice-president and secretary.

Art. 15.—The Director is charged with the general administration and surveillance of the teaching.

Art. 16.—He frequently visits the classes. He ascertains that the regulations are being observed by the masters and pupils, and intervenes for the maintenance of discipline whenever necessary.

Art. 17.—The Director endeavours to impart to the methods of teaching that unity which is so desirable, while allowing at the same time to the teaching-personnel that latitude consistent with the well-being of the school.

Art. 18.—The Director instructs the Department and the School Council on all questions concerning the institution.

Art. 19.—The financial emolument of the Director and the Masters is fixed by the Department at the beginning of each civil year.

Art. 20.—The Director is charged—

(*a*) With the drafting of the time-tables and examinations ;
(*b*) With the inscription in special registers :

1 Of the names of pupils ;
2. Of the absences of pupils ;
3. Of the absences of the masters with the reasons assigned.

(*c*) With the despatch of the reports to parents ;
(*d*) With the organisation and direction of the school-courses, with the help of the teaching-personnel ;
(*e*) With the surveillance of buildings and materials ;
(*f*) With the preservation of archives ;
(*g*) With the drawing up of the annual report concerning the progress of the school.

Art. 21.—The Director and the masters are unanimous in promoting the interests of the institution.

Art. 22.—Excepting in cases of urgency, a master cannot absent himself from his class without previously obtaining the consent of the Director.

The register of the absences of the masters is annually submitted to and signed by the Department.

Art. 23.—The Department may grant a master a maximum *congé* of three days. For a longer period of leave the Department must act upon the advice of the Director.

Art. 24.—The Director has connected with him a secretary, nominated by the Council of State, one of whose functions it is to collect the school fees.

He receives a salary determined by the Council of State, plus a proportion of 2 per cent. of the fees collected.

Art. 25.—The Secretary and Concierge of the school are placed under the immediate orders of the Director. Their functions are determined by the special regulations approved by the Department.

Chapter III.—Pupils.

Art. 26.—The curriculum is divided into obligatory and optional courses of instruction.

The following are regarded as obligatory courses :—French, German, and one other language (English, Italian, or Spanish), Arithmetic, Algebra, Accountancy, and Caligraphy.

Foreign pupils in Switzerland may substitute another language for German.

Art. 27.—The regular pupils are—

(*a*) Those who attend all the courses of a class ;

(*b*) Those who, at the express request of the parents, are allowed by the Conference to attend the courses of their own selection in the same class, at the rate of at least thirty-two hours per week, including the obligatory courses.

Art. 28.—The selection of subjects is made at the end of spring or at the time of entrance.

Art. 29.—The Administrative Courses are for the regular pupils only.

Art. 30.—The pupils who do not fulfil the conditions of attendance Art. 27 are called *auditors*. They must attend a minimum of hours fixed by the Conference.

Commercial apprentices, however, have not to submit to this obligation.

Art. 31.—The entrance-conditions are the same for the auditors as for the regular pupils. They must produce the same documents and prove by an examination that they are capable of following the courses for which they have registered. They are also subject to the same discipline, the same "interrogations," and the same written studies as the regular students.

Art. 32.—The age of entrance to the lower class is 15 years, and one year more for each of the following classes.

Art. 33.—The pupils of the Cantonal Industrial School of the Cantonal College or Communal Secondary Institutions, who have been regularly promoted, are admitted without examination at the beginning of the school-year to the class corresponding to their promotion.

A delay is allowed them, if necessary, until the September vacation, in order to adjust their former studies to the curriculum of the Commercial School.

Art. 34.—Pupils leaving the last year of the higher grade of a primary school of the canton are admitted to the first year, provided they possess satisfactory marks.

Art. 35.—Each request for admission should be accompanied by the school note-book signed by the Department, for pupils leaving the last year of the higher grade of the primary school, and by a special certificate delivered by the Director of the College and signed by the Department for the pupils leaving the Cantonal Industrial School, the Cantonal College, or the Communal Secondary Institutions.

In the case of other candidates, by the birth-certificate, a certificate of vaccination and reports, "*livrets*" or certificates of studies.

Art. 36.—The pupil who does not come under the clauses of Articles 33 and 34 should—

1. Prove by an examination that he possesses the knowledge and development acquired in the higher grade of a primary school, in order to be admitted to the first year of the school ;
2. To pass a satisfactory examination on the programme of the preceding classes, for admission to the second and third years.

The pupil possessing, however, certificates considered satisfactory, may be exempted by the Director of all or part of the examination.

The Director may provisionally admit a pupil who does not fulfil the conditions indicated above, while appointing for him a time for undergoing the examination.

Chapter IV.—Discipline.

Art. 37.—In committing a pupil to the school, the father, guardian, or lawful representative of the parents promises to see that he observes the regulations and holds himself responsible for their non-observance.

Art. 38.—By the very fact of his admission, the pupil is bound to submit to all the prescriptions of the regulations.

Art. 39.—The conduct of the pupil in and outside the school should be decorous. He should be courteous to every-one, should be obedient and respectful to all the masters, and should preserve amicable relations with his fellow-students.

Art. 40.—The pupils are obliged to attend the classes regularly during the whole year.

Late arrivals and absences are registered by the masters and communicated to the Director.

Art. 41.—All absences should be justified on the return of the pupil by a written excuse addressed to the Director, who appraises the reason assigned.

If the absence be of more than three days' duration, the Director is immediately advised.

Petitions for leave should be presented beforehand to the Director.

Latenesses, absences for insufficient reason and tardy justification of an absence entail disciplinary punishment.

Art. 42.—The Director may grant a pupil a leave of two weeks. For a longer period of leave, the Director must consult the Department.

Art. 43.—No pupil is allowed to abandon a course for which he is registered without first presenting to the Director a written request from his father, guardian, or representative.

The Director may grant or refuse this request.

Except in cases of sickness or of great urgency, a pupil may not relinquish a course during the quarter.

Art. 44.—The pupils are prohibited from—

1. Attending the meetings of student societies ;
2. Membership of a society or constituting one among themselves without the consent of the Department.

Art 45.—The pupils who fail in their duty are liable to the following penalties :—

1. Bad marks ;
2. Expulsion from a lesson pronounced by the master, who immediately acquaints the Director therewith ;
3. Denunciation to the Director, who censures the pupil in private or before his comrades ;
4. Deprivation of the use of the library or from participation in the school races ;
5. Notice sent to the parents ;
6. Domestic detention between the lessons, with special work ; these detentions may not exceed eight days ; these sentences are delivered by the Director, who immediately acquaints the parents ;
7. Temporary exclusion or suspension, pronounced by the Director, for eight days at the most, and by the Conference up to three months ;
8. Exclusion for more than three months or definite exclusion, pronounced by the Department at the request of the Conference.

Art. 46. The pupil who desires to leave the school, should, before doing so, send to the Director a declaration from his parents or guardian. Those who have not remitted this declaration continue to be on the school-roll and to pay the school-fees.

Art. 47.—The "*certificats d'etudes*," other than the quarterly bulletins, are granted to those pupils only who have attended the courses for at least one year.

Chapter V.—Work—Promotions.

Art. 48.—The school-year begins in April.

Art. 49.—There are twelve weeks vacation per year. The Department determines their distribution at the beginning of the civil year.

Art. 50.—Every class which numbers more than 30 pupils can be divided into two. This division may take place for languages, arithmetic, and accountancy, when there are more than 25 pupils.

Art. 51.—The work of the pupils is estimated by means of marks averaging from 0 to 10. The questions are as frequent as possible. The marks are communicated to the assembled pupils.

Art. 52.—The work of the pupils is done, as much as possible, by the means of manuals.

Occasionally, lectures dictated by the master or written out by the pupils from notes taken during the lessons, are allowed by the Director

Art.

Art. 53.—In every class and for every division, each important subject must be recapitulated orally or by writing.

Recapitulations take place once a quarter.

The Director is informed of the date of each written or oral recapitulation, as well as part of the programme which will be treated.

Art. 54.—The special studies required of the pupils in view of the recapitulations should be distributed throughout the quarter. Not more than one special study should be imposed per day, nor more than three per week.

As a rule, the written work (compositions, translations, etc.) should be executed in class.

Art. 55.—Greater importance should be attributed to the notes of the special work than to the ordinary notes, on the express condition that the pupils are informed beforehand.

Art. 56.—The master keeps in a "*carnet*" (register) a record of the marks obtained by the pupils. (This register is always subject to inspection by the Director.)

Art. 57.—The average of these marks is entered quarterly, by the master, in a special register. This average is fixed from at least two marks.

The average quarterly marks are forwarded to the parents or their representatives.

Art. 58.—Beside the three quarterly bulletins, a special bulletin is sent, during the quarter, to the parents of those pupils whose work is defective.

Art. 59.—In every class, promotion is based on the work of the year.

Art. 60.—In order to establish the numbers relative to the promotion of regular pupils, the branches of studies are divided into two groups.

The first group—obligatory branches—includes French, German, and one other language, Arithmetic, Accountancy, and Caligraphy.

The second group includes all the other branches.

Art. 61.—To be eligible for promotion, the regular pupils should obtain at least—

(*a*) Six-tenths of the maximum for all the branches;
(*b*) Six-tenths of the maximum for the obligatory branches.

In addition, he should not have a mark lower than six for these last subjects.

Sometimes the Conference may take account of exceptional circumstances for granting or refusing promotion.

Art. 62.—No pupil is allowed to remain longer than two years in the same class.

Art. 63.—The auditor may only attend the courses for which he has obtained in the preceding class, an average mark of at least six (6).

Chapter VI.—Examinations.

Art. 64.—At the end of the third year of the Commercial School and the second year of the Administrative Courses, regular pupils undergo an examination with the object of gaining a diploma.

This examination bears on the complete programme of the courses; it is public.

Art. 65.—The examination includes written and oral tests.

The subjects of the written tests must be approved of by the Director.

Art. 66.—The examination is conducted by committees of three members, viz., two experts appointed by the Department, on the advice of the Director, and the master.

The master directs the "interrogation"; the experts may address questions within the limits of the curriculum.

Art. 67.—At the end of the examination of each branch, the committee forwards to the Director the list of marks, together with any observations that it considers necessary to make.

Art. 68.—All fraud or fraudulent attempts is punished by awarding zero in the paper wherein it occurs.

Art. 69.—In the Commercial School, the examination for languages, arithmetic, and accountancy takes the form of a written and an oral test, which are of equal value.

For history, geography, chemistry, knowledge of merchandise, political economy, and commercial law, the examination is oral merely.

Art. 70.—In the Administrative Courses, the examination in French, German, Italian (English optional), and arithmetic takes the form of a written and an oral test.

In history and civic instruction, geography, special physics, chemistry, political economy, the special courses in each division (postal, telegraphic, customs), it is oral only.

Art. 71.—For the obtainment of the diploma, the three bulletins of the last year count for three-fourths, the bulletin of the examination, one-fourth.

Art. 73.—For the courses which are not represented on the curriculum of the preceding year, the mark registered to the diploma is that of the last annual average.

Art. 73.—The Conference is empowered to refuse the diploma to the candidate who, while attaining the average marks required by the regulations, may obtain marks judged insufficient in any one of the subjects whatsoever of the programme.

Such a candidate may submit to complementary tests at a period fixed by the Conference within the six months subsequent to the first examination.

Chapter VII.—Competitions.

Art. 74.—Subjects for competition are annually proposed to the pupils of the school.

A special regulation determines the details of organisation of the competitions.

Art. 75.—Each study is referred to the appraisement of a committee of three members.

Art. 76.—For these competitions prizes may be awarded within the limits of from 15 to 60 francs.

Chapter VIII.—Fees and Bursaries.

Art. 77.—The annual school-fees for regular pupils are as follow:

For *Swiss pupils:* 60 fr. (£2 8s.), 25 fr. (£1), payable in April, and 35 fr. (£1 8s.) in September.
For *Foreign pupils:* 120 fr. (£4 16s.), 50 fr. (£2), payable in April, and 70 fr. (£2 16s.), in September.
For regular pupils admitted since 31st December, the fee is reduced to 25 fr. (£1) for Swiss pupils, and to 50 fr. (£2) for foreign pupils.

Art. 78.—When two or more brothers are regular pupils of the cantonal institutions of secondary education, the eldest only pays the full fee; the others, half.

Art. 79.—The fee of the term entered upon must be paid, whatever the reason may be which obliges the pupil to discontinue.

Art. 80.—The auditors pay, for each hourly course per week, the following fees:—

	Swiss.		Foreigners.
(*a*) For the period of from April to July	1·50 fr. (1s. 2½d.)	...	3 fr. (2s. 4½d.)
(*b*) ,, September to April	3·50 fr. (3s. 7½d.)	...	7 fr. (7s. 3d.)

The maximum of the fees for auditors is—

(*a*) For the period of from April to July		35 fr. (£1 8s.)	...	70 fr. (£2 16s.)
(*b*) For the period of September and October	To the end of the school-year	90 fr. (£3 12s.)	...	180 fr. (£7 4s.)
,, November and December		70 fr. (£2 16s.)	...	140 fr. (£5 12s.)
,, January and February		50 fr. (£2)	...	100 fr. (£4)
,, March		35 fr. (£1 8s.)	...	70 fr. (£2 16s)

Art. 81.—The regular pupils who become auditors during the school-year pay the fee mentioned in the preceding article, with deduction of the amount paid as regular pupils.

Art. 82.—All the pupils pay an annual fee of 5 fr. (4s.) for the school-library and various equipments.

Art. 83.—Foreign pupils, whose parents have lived in the canton for at least *ten* years, and who also pay taxes, enjoy the same privileges as natives.

Art.

Art. 84.—In cases of pecuniary limitations on the part of the parents, the pupils are taken for half-fees, and sometimes no fee at all is charged. Duly alleged petitions for exemption should be presented to the Director in writing on a special form, at the beginning of the school-year.

Exemptions are granted by the Council of State for the current school-year. Petitions should be presented anew each year.

Art. 85.—Bursaries may be granted to deserving pupils when the parents so request by reason of their financial position.

The petitions should be presented in writing to the Director on special forms, at the beginning of the school-year. A fresh petition should be annually presented.

The beneficiare of a bursary is exempted from school-fees. (See Arts. 41 to 44 of the General Regulation.)

Art. 86.—In cases of complaint against a pupil exempted from the fee or in the possession of a bursary, the Conference can demand its suppression.

Art 87.—The pupils are allowed to attend the following cantonal institutions:—The Cantonal Library, the Museums, the School of Design, the Fencing and Riding School, subject to the conditions fixed by the special regulations. The Director gives the necessary declarations to this effect.

Art. 88.—The present regulation immediately becomes law.

Given under the seal of the Council of State, at Lausanne, 7th January, 1902.

20. *Commercial School at the "Technikum," Winterthur.*—The Commercial School at Winterthur, Switzerland, is a section of the "*Technikum des kantons Zürich.*" It has six classes of a half-year each, the programme being as follows:—

Programme of the "Handelsschule des Technikums," Winterthur.

Subjects.	Classes and Hours per Week.						
	I.	II.	III.	IV.	V.	VI.	Totals.
German ...	3	3	3	3	3	3	18
French ...	4	4	4	4	4	4	24
English ...	4	4	4	4	4	4	24
Italian ...	3	4	4	4	4	4	23
Spanish (optional) ...	...	...	(2)	(2)	(2)	(2)	8
Conversation on Economics ...	...	...	...	..	2	2	4
Accountancy, Book-keeping ...	4	4	4	4	...	...	16
Economics ...	...	...	2	2	...	...	4
Customs ..	...	...	...	..	...	2	2
Arithmetic of Economics ...	...	...	2	2	...	...	4
Algebra ...	2	2	...	...	...	...	4
Geography ...	2	2	...	...	...	...	4
History of Commerce and Civilisation ...	2	2	2	...	...	...	6
Physics ...	3	3	...	...	...	...	6
Chemistry ...	3	3	...	...	...	...	6
Caligraphy ...	2	2	...	...	...	...	4
Stenography ...	2	1	...	...	...	...	3
Law of Exchange and Commercial Law ...	...	...	2	2	2	...	6
Commercial Geography ...	...	...	2	2	2	2	8
Merchandise ...	...	...	2	2	...	...	4
Insurance ...	...	...	...	...	2	2	4
Post and Railway Tariffs ...	...	...	...	...	2	...	2
Laboratory Practice ...	...	...	...	...	2	3	5
Commercial Bureau ...	...	...	...	3	5	5	13
Totals ...	34	34	31 (33)	32 (34)	32 (34)	31 (33)	194

21. *Scheme of Instruction, Commercial School at Winterthur.*—The details of the programme are developed as shewn hereunder. They serve to disclose how far agreement or otherwise exists between French and German Switzerland. The course represented is that of the year 1902–3, the year current on the occasion of the Commissioners' visit. The details are as follows:—

Class I (Summer).

German (3 hours per week).—Prose and poetry, exercises in oral expression, recapitulation of the theory of word formation, composition.

French (4 hours).—Grammar, beyond the grade of the instruction in the Zurich Secondary School. Translations. Dictations. Exercises in reading, memorising, and conversation.

English (4 hours).—Pronunciation and accentuation. Etymology. Translation. Exercises in reading, memorising, and conversation.

Italian (3 hours).—Course for beginners. Grammar (article, substantive, adjective and verb). Translation. Exercises in reading, memorising, and conversation.

Accountancy and Book-keeping (4 hours).—Recapitulation and extension of the subjects as treated in the Zurich Secondary School, paying special attention to proportion, percentage, and interest. Written and oral solution of common problems. Making of inventories, official computations of every description.

Algebra (2 hours).—Recapitulation of the elements. Theory of powers and roots. Equations of the 1st degree.

Geography (2 hours).—Elements of mathematical and physical geography. The orographical, hydrographical, climatic, and ethnographical situation of Europe.

The History of Commerce and Civilisation (2 hours).—View of the history of commerce and civilisation of antiquity and the Middle Ages, with special regard to the Hanseatic League and the Italian States.

Physics (3 hours).—The experimental elements of physics. The general properties of bodies. Equilibrium of liquid and gaseous bodies.

Chemistry (3 hours).—Metalloids and their important compounds.

Caligraphy (2 hours).—Latin round-writing.

Stenography (2 hours).—Course for beginners in stenography, following the Stolze-Schrey system.

Class II

Class II (Winter).

German (3 hours per week).—Reading and explanation of classical prose works. Exercises in oral expression. Recapitulation of syntax. Special art of composition, with particular reference to business customs.
French (4 hours).—Syntax. The other subjects are the same as in Class I.
English (4 hours).—The theory of forms in systematic succession. Oral and written exercises on special passages read.
Italian (4 hours).—Grammar, continuation of pronouns, adverbs, conjunction, irregular verbs. The other subjects are the same as in Class I.
Accountancy and Book-keeping (4 hours).—Calculation of bullion with respect to varying density, fineness, and current value. Proportion of gold and silver. Introduction to the lesson in accounts-current. English accounts-current. Calculation of exchange discount. The elements of book-keeping. Book-keeping by simple entry. Application to simple business operation. Preliminary studies of book-keeping by double entry.
Algebra (2 hours).—Equations of the 2nd degree. Logarithms.
Geography (2 hours).—Orographical, hydrographical, climatic, and ethnographical situation of America, Asia, Africa, and Australia.
History of Commerce and Civilisation (2 hours).—Original treatment of the discoveries. Summary of the history of commerce and civilisation of modern times. Natural economics of the Middle Ages and monetary economics of modern times. Mercantilism and physiocracy and their connection with absolute Monarchy. Colonial policy.
Physics (3 hours).—Heat, magnetism, electricity, and optics.
Chemistry (3 hours).—Metals and their most important compounds. Summary of organic chemistry.
Caligraphy (2 hours).—German current-writing. Round-writing.
Stenography (1 hour).—Practice in shorthand. Recapitulation.

Class III (Summer).

German (3 hours per week).—Reading and explanation of the great epic and lyric poems. Written work and elocutionary exercises. History and etymology of the modern High German. The elements of prosody.
French (4 hours).—Syntax. Conclusion. Extemporising. The other subjects are identical with those of Class II. *The instruction is given in the French language.*
English (4 hours).—Syntax, 1st part. Oral and written exercises. Reading of narrative and descriptive prose. Conversational exercises.
Italian (4 hours).—Grammar, conclusion. Syntax. Translation. Exercises in reading, memorising, and conversation. Reproduction of simple compositions.
Spanish (optional, 2 hours).—The theory of pronunciation and the elements of etymology. Exercises in reading and memorising. Written and oral translations.
Accountancy and Book-keeping (4 hours).—Continuation and conclusion of the theory of account-current. The solution of examples from business with compound rate of interest according to various methods. The theory of the course of exchange. The par of exchange by equal and varying standards. Written and oral exercises in the direction of exchange reductions. Calculation of merchandise. The theory of book-keeping by double entry. Arrangement of the book according to the Italian and German system. Application of the Italian systems to a four-yearly business course of a joint-stock company.
Economic Arithmetic (2 hours).—Progessions. Calculation of interest. Annuities. Various forms of loans. Construction of schemes of liquidation by anticipative, yearly and half-yearly payment of interest. Loan lotteries.
Law of Exchange (2 hours).—History of Switzerland. Legal obligations. Nature and significance of exchange in general. Bills of exchange and their constituent elements. The theory of acceptance, endorsement, protest and recourse. "*Notadresse*" and intervention. Duplicates and copies. Superannuation notes drawn upon oneself and cheques. Other indorsable paper. Bearer of bills. Comparison of legal obligations with the same under German law regarding bills, with the Commercial Code and the English law.
Economics (2 hours).—Introduction to economics by discussion of an individual economic fact touching the notions of value, property, economics, political economy. The theory of the production of wealth with special reference to national industrial power, capital, and the division of labour.
Commercial Geography (2 hours).—The position of the most important States of Europe with reference to trade and commerce. Their political and social relations and the influence of these on economic development. Primitive production. Industry. Commerce. Transport. Economical legislation. Exercises in the graphical representation of statistics.
History of Commerce and Civilisation (2 hours) —The French Revolution and the 19th century. Elementary treatment of the development of Switzerland from 1798 to the present time.
Knowledge of Merchandise (2 hours).—The most important articles from the mineral kingdom. Estimate of their value; demonstration of adulterations.

Class IV (Winter).

German (3 hours per week).—Summary of the most important phænomena of German literature to the death of Gottsched. Leading features of poetry. Reading and explanation of the classic poems and poets. Written work, with special reference to essay writing. Exercises in oral expression.
French (4 hours).—Recapitulation of the syntax. Reading, memory work, and conversational exercises. Commercial correspondence. Translation of the German prose works.
English (4 hours).—Syntax, Part II. Written and oral translations. Reading of essays dealing with the English and American national languages. Exercises in conversation. Simple compositions.
Italian (4 hours).—Syntax, continuation. Reading, memorising, and conversation. Easy essays. Private and commercial correspondence. Translation of one of the German prose works. The instruction is given in the Italian language.
Spanish (optional, 2 hours).—Systematic etymology. Exercises in reading and conversation and in oral and written translation.
Accountancy and Book-keeping (4 hours).—Indirect exchange reductions and commissions. Trade or commercial arbitration. Synopsis of the most important Bills of Exchange and their value. Business arbitration. Mixed calculation of goods. Tables of Calculation-tables and parities of values. Conclusion of the theory of book-keeping by double entry. Arrangement of books according to the column system.
Bureau-work (3 hours).—Exercises in the execution of simple Bureau-work: Bills of lading, declarations, bills, notes, invoices, etc. Composition of simple documents, as bills of exchange, letters of advice, remittance, receipts, etc., in the German language. Keeping and registration of copy-books.
Arithmetic of Economics (2 hours).—The elements of the calculation of probabilities and their application to the construction of the table of mortality. Fundamental tables. Theory of life-annuity. Prolongation and temporary life-annuity. Insurance payable at death and during life. Disease statistics and health insurance.
Economics (2 hours).—The theory of the circulation of wealth: Value, mass, and density, monetary system, credit and banking affairs, the transport system. Division of wealth: Wages, interest on the capital, proceeds of enterprises and ground-rent. Consumption of wealth.
Commercial Law (2 hours).—Explanation of the most important statements of the laws of obligations by discussion of suitable examples and passing of judgments.
Commercial Geography (2 hours) —Commercial geography of the Union from the point of view of the treatment of Europe. The economical position of Canada and Mexico and the States of Central and South America, with special regard to their commercial relations with Europe. Continuation of the exercises in graphical representations of statistics.
Merchandise (2 hours).—The most important products of the vegetable and animal kingdom. Instruction with regard to their valuation and adulterations.

Class V (Summer Semester).

Reading and explanation of the dramatic poets. Review of the most important phænomena of German literature from Gottsched to the death of Goethe. Essays and lectures.
French (4 hours).—Voluntary compositions. Correspondence. History of literature. The most important periods of French literature from its beginning to the age of Louis XIV. Free elocutionary exercises on given themes. Reading in connection with the history of literature.

English.

English (4 hours).—Recapitulation of the Grammar, with special regard to the peculiarities and chief difficulties of the construction of the English language. Readings of the classical prose works, combined with conversational exercises. Composition of business documents. *The instruction is given preferably in the English language.*

Italian (4 hours).—Recapitulation of the most important parts of the syntax. Essays. Correspondence. History of literature. Origin of the language, the most important early authors, the humanist, the Renaissance. Readings in connection with the history of literature.

Spanish (optional, 2 hours).—Syntax, 1st part. Oral and written translations. Reading and explanation of simple Spanish classical extracts. Conversational exercises.

Bureau-work (5 hours).—Continuation of the exercises of Class IV. Conducting simple correspondence in French. Extension of the correspondence to German. Registering of simple letters and invoices. Intensive exercises in commercial arithmetic. Arrangement and keeping of the books of a manufacturer's business.

Commercial Geography (2 hours).—Importance of the seas as highways of commerce. The economic position of Arabia and North-east Africa, including Zanzibar. The Barbary States and their importance for Europe. Senegambia. The Congo State. Cape Colony. Madagascar and its attitude to French. Cartographical plans of the European colonies in Africa.

Politico-economic Conversations (2 hours).—Discussion upon economic and commercial questions. Written work. Lectures.

Insurance Matters (2 hours).—Insurance in general. Various kinds of insurance. Fire insurance. Insurance against damage done by hail; insurance of cattle. Transport insurance in its various forms and just elements.

Postal and Railway Tariff (2 hours).—The development of the Postal System. The Swiss postal-tariff. The Postal Union. The Postal tariff. The principles of the Railway tariff. Goods tariffs. General and special tariff. The system of classification and weight. Differential tariffs. Particular tariff and reductions in freight. Exercises in the calculations of freights. Control of bills of lading.

Commercial Law (2 hours).—The law relating to bankruptcy. Laws concerning patents, designs of patents, and trade-marks.

Laboratory (2 hours).—Experiments in simple qualitative analyses. Examination and valuation of inorganic commercial productions.

Class VI (Winter).

German (3 hours per week).—The principal phænomena of the literature of modern times. Participation of Switzerland in the development of German literature. Reading and explanation of the poetry of modern times. Free discussions. Recapitulation.

French (4 hours).—Free compositions. History of literature. The most important phænomena from the time of Louis XIV to the present time. Readings and elocutionary exercises upon given subjects. Reading and explanation of classical works.

English (4 hours).—Reading and explanation of the classical works in concise form. Exercises in conversation and continuation of the recapitulation of the grammar in the direction of the reading selections. Commercial correspondence. Synopsis of the history of English literature.

Italian (4 hours).—Essays. Correspondence. Elocutionary exercises upon given subjects. History of literature. The most prominent phænomena of the three last centuries. Reading and explanation of classical selections.

Spanish (optional, 2 hours).—Syntax, Part II, and recapitulation of the whole etymology. Reading and explanation of selections in prose and poetry, and conversational exercises in connection therewith. Attempts at independent performances.

Bureau-work (5 hours).—Continuation of the exercises of Classes IV and V. Maintenance of simple correspondence in English and Italian. Conclusion of the correspondence in German. Preparation of market and exchange reports. Management of commission and partnership businesses by bank, and merchandise traffic. Arrangement and keeping of books and the whole accounts, together with the correspondence of a collective company or a joint-stock company.

Politico-economic Conversation (2 hours).—Discussion of economic and commercial questions. Written work. Lectures. Recapitulation.

Insurance Matters (2 hours).—Life insurances in their various forms and legal elements. Accident, disease, old-age, and invalid insurance. Recapitulation.

Commercial Geography (2 hours).—Commercial geography of Asia, with special regard to India, Japan, China, and the Dutch colonies. The English colonies in Australia. The Polynesian Archipelago. Recapitulation. Cartographical view of the colonies in Asia and Australia.

The Customs (2 hours).—The historical development of the Customs. Import, export, and passing through of the Customs. Protective duties and finance duties. Prohibition duties. Excise, export bonus and drawbacks. Duties on values and weight. The Customs tariff of the various States. Commercial treaties.

Laboratory (3 hours).—Introduction to the technics of the microscope. Microscopical inspection of food and fabrics belonging to the textile industry. Simple quantitative determinations.

22. *Concluding Remarks.*—Apart from the thoroughness with which the courses are developed, it may be said that the museums of commercial material, the laboratory instruction, and the intense specialisation of the teaching, make the schools of commerce of Switzerland valuable elements in practical education.

The schools in the Italian cantons are not referred to, though the development of commercial education in them is also remarkable.

CHAPTER LXI

CHAPTER LXI.

Programme of Commercial Education in Neuchatel.

[J. W. TURNER.]

THE COMMERCIAL SCHOOL, NEUCHATEL, SWITZERLAND.

Among the important commercial high schools of Europe, the Commercial School of Neuchatel takes rank second to none. In some respects, indeed, it is even superior to the schools of Leipzig and Antwerp. As it stands out prominently among the great commercial institutions of Europe, its programme is given in detail.

PROGRAMME OF COMMERCIAL SCHOOL (COMPLETE COURSE), NEUCHATEL, 1902–1903.

General Organisation.

The Commercial School was founded in 1883 by the City of Neuchatel, at the request of a number of local merchants and manufacturers. It comprises at the present time :—

(1.) The Commercial School proper, with a four years' course.

At the end of the third year the students promoted to the higher class receive a "Certificat d' Etudes"; at the end of the fourth year the students who pass with success the examinations receive a diploma. The conditions to be fulfilled in order to obtain these certificates are fixed by a special regulation.

The school possesses a library and a museum of specimens which are at the service of the students.

It has also a microscopic and a chemistry laboratory, in which the students of the two higher classes may work every day for the purpose of analysing the most important articles of merchandise, and of recognising the chief adulterations.

Auditors are not admitted except to the highest class; they must show by examination that they possess sufficient knowledge to follow the courses they desire to attend; for these courses they are subjected to the same rules as the regular students.

(2.) The Modern Language Section.—This includes a preparatory class and two divisions, each having several parallel classes according to the number of students.

(3.) The Postal and Railway Sections, intended for the preparation of youths desirous of entering the one or other of these services.

There are, in addition,—

(*a*) A Preparatory Course of three months' duration, commencing on the 15th April, to prepare pupils who arrive in the spring to enter, in the autumn, one or other of the school classes.

(*b*) A Holiday Course of six weeks, from the 20th July to the 15th September, to continue the work of the Preparatory Course.

(*c*) A special class in French, to which are admitted at any time students who come to Neuchatel without such knowledge of the language as will enable them to be admitted to one of the school classes.

The Commercial School.

The Commercial School, like all the other official institutions of the city, is non-residential, and the students whose parents do not live at Neuchatel are placed in private families or boarding houses.

The Commercial School is controlled by a Committee whose members are chosen from the heads of the most important commercial houses of the city. The members of the Committee visit regularly the classes so as to acquaint themselves with the manner in which the lessons are given, and with the modifications thought necessary to introduce into the programmes.

The school year commences on the 15th September and ends on the 15th July; three weeks' holidays are given at the new year and ten days at Easter.

Lessons commence at 7 in the morning in summer, and at 8 in winter; in the afternoon at 2 throughout the year.

The lessons finish at 12 in the morning, and at 7 in the evening.

Conditions of Admission.

The minimum age of admission is 15 years, and, except in the fourth commercial year, only regular students are admitted. In addition to the compulsory courses, the students must follow a certain number of optional courses, left to their own choice, so as to make up the minimum number of hours fixed for each class.

There are admitted into the first year of the Commercial School, into the lower division of the Modern Language Section, into the Postal and Railway Section, into the Preparatory Course, and into the Special Class :—

(*a*) Those who possess a certificate showing that they have attended courses given in accordance with a programme similar to that of the Swiss secondary schools. The Director grants or refuses admission, according to the notes inscribed thereon.

(*b*) Those who, while not possessing this certificate, show by examination, that they have sufficient general knowledge.

There are admitted into the second, third, and fourth years of the Commercial School, and into the upper division of the Modern Language Section :—

(*a*) Students promoted from the preceding class.

(*b*) Those who successfully undergo an examination bearing on the work of this class.

Fees.

Fees.

Enrolment Fees = 5 Francs.

Foreign Students.

Commercial School and Special Class.—Students entering before the 31st December: 100 fr. at the time of enrolment; 150 fr. in January. Students entering after the 31st December: 150 fr. at the time of enrolment.

Modern Language Section.—Students entering before the 31st December: 120 fr. at the time of enrolment; 180 fr. in January. Students entering after the 31st December: 180 fr. at the time of enrolment.

Swiss Students.

The expenses of the school being partly covered by Federal subsidies, the Swiss students enjoy a reduction on the amounts above stated, and the fee is fixed for them as follows:—

Commercial School and Special Class.—Students entering before the 15th December: 50 fr. at the time of enrolment; 75 fr. in January. Students entering after the 15th December: 75 fr. at the time of enrolment.

Modern Language Section.—Students entering before the 15th December: 60 fr. at the time of enrolment; 90 fr. in January. Students entering after the 15th December: 90 fr. at the time of enrolment.

Postal and Railway Section.—100 fr. payable at the time of enrolment. Students who desire to take up in April the Preparatory Course pay an additional fee of 25 fr.

For the Preparatory and Holiday Courses, see table.

Auditors pay, besides the enrolment fee, 6 fr. a year for each lesson received weekly. The total amount demanded of them cannot exceed the amount of fees paid by the regular students; it is payable in one sum upon enrolment.

For teachers who possess a diploma granted by a Swiss canton, the amount of fees is reduced one-half.

Exemption from fees may be granted by the School Committee.

Hours devoted each week to the different subjects.

Preparatory and Holiday Courses, Modern Languages and Postal and Railway Sections.

Subjects.	Preparatory Course.		Holiday Course.	Modern Language Section. Division.			Postal and Railway Section.	
	French Students.	Foreign Students.		Preparatory.	Lower.	Upper.	French.	German.
French	4	12	12	24	20	20	6	10
Arithmetic	3	6	3	...	2	2	2	2
,, Special	...	...	...	...	...	...	4	4
Book-keeping	3	6	3	...	2	2	...	...
Geography, General	...	...	...	...	2	2	2	2
,, Special	...	...	...	...	...	...	4	4
Caligraphy	2	2	...	...	2	2	2	2
German	12	...	...	...	4	4	6	2
English	4	4	...	...	4	4	...	...
Italian	4	4	...	...	4	4	...	...
Spanish	...	...	...	...	4	4	...	...
Russian	...	...	...	...	4	4	...	...
Stenography	...	...	..	...	...	...	2	2

Commercial School.

Subjects.	First Year.			Second Year.			Third Year.			Fourth Year.		
	French.	German.	Foreign.	French.	German.	Foreign.	French.	German.	Foreign.	French.	German.	Foreign.
Commercial Office	10	10	10	10	10	10	10	10	10	6	6	6
Legislation	...	...	...	2	2	2	3	3	3	4	4	4
Industrial Law	...	...	...	...	...	...	...	...	...	1	1	1
Railway Law	...	...	...	...	...	...	...	...	...	1	1	1
French	6	10	10	4	10	10	3	6	6	2	5	5
German	6	2	4	6	2	4	4	2	4	4	2	4
English	4	4	4	4	4	4	4	4	4	4	4	4
Italian	4	4	4	4	4	4	4	4	4	4	4	4
Spanish	4	4	4	4	4	4	4	4	4	4	4	4
Russian	4	4	4	4	4	4	4	4	4	4	4	4
Political Economy	...	...	...	...	...	...	2	2	2	2	2	2
Contemporary History	...	...	...	...	...	...	...	...	...	2	2	2
Chemistry	2	2	2	2	2	2	1	1	1	...	...	...
Physics	...	...	...	...	...	...	1	1	1	2	2	2
Commodities	...	...	...	...	...	...	2	2	2	...	...	...
Adulterations	...	...	...	...	...	...	4	4	4	4	4	4
Algebra	2	2	2	2	2	2	...	...	...	...	...	...
Caligraphy	2	2	2	2	2	2	2	2	2	2	2	2
Stenography	2	2	...	2	2	...	1	1	...	1	1	...
Dactylography (Typewriting)	...	...	...	...	...	...	2	2	2	2	2	2
Geography, General	2	2	2	...	...	...	...	...	...	...	...	...
,, Commercial	...	...	...	2	2	2	2	2	2	1	1	1
Current Geographical Events	...	...	...	...	...	...	...	...	...	1	1	1
Physical Exercises	2	2	2	2	2	2	2	2	2	2	2	2

PROGRAMMES.

Preparatory Course.

All the courses are optional. The pupils are compelled to attend at least thirty hours a week.

For all the branches of work, parallel or superposed courses are organised of sufficient number to enable the classes to be always small in size.

French.—For French students, fours hours a week. Grammar and Orthography—Composition, etc.
„ Foreign students, twelve hours a week. Translations, Dictation, etc.; Composition, Correspondence.
Arithmetic.—Decimals, Metric System, Interest, Discount, etc.
Book-keeping.—General Ideas.
Caligraphy.—Two hours a week.

Foreign Languages.

Italian. English.

General Programme.

Grammar.—(*a*) Parts of Speech. (*b*) Translation of easy passages. Vocabulary—Names of common objects employed in the school, of articles of furniture, etc. Descriptions of such objects. Dictation containing words studied.

This programme is designed merely to give a general idea of the course of instruction; each teacher devotes all the time necessary to the special difficulties that each language presents, and which it is unnecessary to detail here.

Alongside of the ordinary course, the programme of which alone is shown, other courses are organised corresponding to those of first and second years. To be admitted to one of these courses the pupils must know the subjects taught in the previous courses.

The lessons are given as much as possible in the language studied.

The intuitive method, adapted to the age and knowledge of the students, is employed in the lower course; in all the classes great prominence is given to the exercises in conversation.

The classes are always small, averaging ten pupils.

German.—For French pupils. Conversation about presented objects and pictures. Reading of selected passages, etc.
Grammar.—Important parts of speech and the common verbs. Dictation, Translation, etc.

Students desirous of directly entering one of the upper classes follow a part of the course above indicated, and receive in addition every week ten or twelve special lessons designed for the repetition of the leading points of the programme of the lower classes. For these pupils, attendance at one of the Holiday Courses is compulsory.

If the number of students desirous of entering the Postal and Railway Sections is sufficient, special courses are organised for them.

Holiday Course.

Every year, from the 20th July to the 10th August, and from the 20th August to the 15th September (approximate dates), a holiday course of six weeks, broken by a fortnight interval, is organised for foreign students who desire to remain at Neuchatel and continue the study of the languages and commercial subjects. The fee is 30 francs.

Programme as shown in preceding table.

Special French Class.

24 hours a week.

The pupils in this class are always very small in number; this enables the work to be almost entirely individual. They may follow other courses, should they desire to do so. As soon as they are sufficiently advanced in French, they enter one of the classes of the Commercial School.

(1.) COMMERCIAL SCHOOL.

FIRST YEAR.

Parallel or superposed classes organised as stated above.

Compulsory Courses.

Commercial Bureau.

Commercial Ideas.—Commerce in General.—Wholesale and Retail; Internal and International; Imports and Exports. Purpose of Commerce; Dangers, Means for avoiding them; Function of Book-keeping; Merchants, Bankers, Agents, Commercial Travellers, &c.
Arithmetic.—Decimals, Metric System, Interest, Discount, etc. Postal Tariffs, etc. Exercises in rapid mental work.
Book-keeping.—Its purpose; Day-book, Ledger, Balancing, etc.
Commercial Legislation.—Practical ideas; Promissory notes.
French.—Study of words and conversation; Practical study of the grammar. Composition, Dictation, Reading of Modern Authors, Recitations, etc.
Caligraphy.—Commercial Writing; Minute study of small and capital letters; Figures; Headlines of Letters; Commercial Documents; Visiting Cards.
Geography (General).—Reading of Maps; Neighbourhood of Neuchatel: Minute study made on the land itself of a map at a scale of 1 to 25,000 of the Siegfried Atlas.
Geography (Political).—Expansion of Races; Principal Countries of World; Industrial and Commercial Cities, Ports, and Colonies.
Stenography (for French Students).—Aimé Paris System; First abbreviations.
A Foreign Language.—French students are compelled to take German as well as a second foreign language.

Optional

Optional Courses.

Foreign Languages.

German; English; Italian; Spanish; Russian.

General Programme.—(*a*) Preparatory course recapitulated; common irregular verbs; prepositions; translations, dictation; (*b*) Reading of selected passages, conversation on passages read, vocabulary; (*c*) compositions.

Chemistry.—(1) General ideas: matter, molecule, atom, symbols, etc.; (2) Study of the chief elements and their combinations.

Non-metals = hydrogen, oxygen, etc.

Metals = potassium and sodium, zinc, etc.

Algebra.—Positive and negative quantities: additions, subtractions, etc.; equations of one unknown, problems.

Stenography.—For German students, Stolze-Schrey system. Chief rules of shorthand, reading, etc. Manual by R. Schwarz.

Physical exercises.—Gymnastics, swimming, running, &c.

SECOND YEAR.

Compulsory Courses.

Practical Bureau.

During the first month, a course in book-keeping is given, completing the ideas acquired in the preparatory course. During this period, the students study in the theoretical bureau, arithmetic and legislation, invoices, routes and means of transport, the computation of interest, memoranda, promissory notes, etc.,—in a word the documents and calculations most commonly employed in a commercial house.

The class then represents a commercial house established in a Swiss city whose books and correspondence are in the hands of the students. The class receives daily the quotations of the place on which it operates; it receives also offers of service from the students of the third year, and decides, after acquainting itself with all the expenses affecting the goods, to place its order in one town or another. The order is given; a few days after, the invoice and way-bill are received; the expenses are entered in the cash-book, the invoice in the purchase book, and the cost price having been worked out, the sale commences.

The house accepts in payment bills at the current rates, and studies the most convenient method of regulating its different purchases.

It is engaged too in banking transactions, discounting of bills, purchases and sales of public stock, etc.

It sells on account of a third party and sends goods itself to its agents.

The books in use are:—*Essential Books*—Cash Book, Bills (receivable and payable), Purchases and Sales, Public Stock, Book of Sundries, Ledger, Current Accounts, Stock Book.

Theoretical Bureau and Commercial Arithmetic.

Commercial Ideas.—Revision; Exchange; Purchases and Sales; Function of Money; Letters of Exchange and Notes of Exchange and Cheques; Bank Notes and Paper Money. Art of Buying and Selling, economic and moral principles. Knowledge of the Articles of Commerce, of the markets, and openings for trade. Customs, Bonds, Warehouses. Markets, Fairs, and Stock Exchanges.

Commercial Arithmetic.—Revision of First Year; Memoranda of National Bills on places at which banking may or may not be done; Stamp Tariffs (Swiss and Foreign). Current Accounts, direct, indirect, Hamburg methods, and private cases.

Bills and Invoices, Accounts of purchases and sales, Abstracts of Sales, English Invoices. Routes and Means of Transport. General Conditions of the working of the Swiss Railway Lines. Way-bills, Receipts, and Warrants. Tariffs of the Swiss Railway Lines. Freight of Goods of the chief articles of commerce from Marseilles, Havre, Antwerp, Hamburg, Geneva, etc.

Tariffs of the Swiss Customs; Cost price and Minimum prices of sale.

Exchange.—General Ideas; Memoranda of Foreign Bills; Comparison and Transformation of Market Prices; Current Exchanges of the chief Swiss and Foreign places.

Public Stock.—General Ideas; Different classes of Shares and Bonds. Memoranda of Shares, Bonds, Coupons. Exchange Transactions for the placing of Capital; Quotations of the chief towns.

Coins of the chief countries; Posts and Telegraphs; Tariffs.

Book-keeping of a Retail House; Household Book-keeping.

Commercial Legislation.—Bills, Letters of Exchange, Bills of Exchange, Cheques, Essential Elements, Indorsements and Acceptances, Payment of Bills, Action in default of Payment, Protests, Notary's Charges, etc., Foreign Bills.

Mental Arithmetic.—Simple Operations, Vulgar and Decimal Fractions, Measures, Interests, and Discounts.

Quick Reckoning.—Numerous exercises on the various subjects studied in the Commercial Arithmetic.

French (for French Students).—Grammar, Composition, Recitations, etc.

(For Foreign Students).—Study of Words, Conversation, Practical Study of the Grammar, Dictation, Composition, etc.

Caligraphy.—Cursive, Round, Gothic, Commercial Documents, etc.

Stenography (French Students).—Aimé Paris System, Commercial Stenography, etc.

Foreign Language.—French students must take German.

The Geography and Chemistry Courses are compulsory for students desirous of entering the Third Year.

Optional

Optional Courses.

German.—Compulsory for French students.

English, Italian, Spanish, Russian.

General Programme:—(*a*) Grammar.—Verb, Adverb, Conjunction, etc., Construction of Sentences, Translation, Dictation; (*b*) Conversation in connection with passages read, etc; (*c*) Composition.—Study of Model, Private and Commercial Letters.

In the first and second years the lectures are given as much as possible in the languages studied. In the third and fourth years the lessons are given exclusively in that language.

German.—Special course of reading for the German students.

Modern German Literature.—Hebbel, Ludwig, Keller, Heyse, etc., Composition, etc.

Stenography.—Special course for German students as in first year.

Commercial Geography.—Europe—Revision of physical and political geography with lantern views, to give the pupils an idea of the configuration of the land, the principal monuments, the distribution of races, languages, and religions.

Economic and Commercial Geography.—Mineral and vegetable productions, industrial and agricultural districts, routes, imports and exports, merchant fleets, colonies.

Tables of statistics with diagrams are studied; emphasis is placed rather on the proportion of the different agricultural and industrial products, of the imports and exports, than on the memorizing of numbers in their nature variable.

Chemistry.—

1. General ideas—Composition of matter, molecule, etc.; chemical combination, decomposition, reaction; elements and compounds; atomic and molecular weight, etc.
2. Detailed study of the elements, their combination and uses; non-metals=hydrogen, oxygen, &c.
3. Metals.—General character; physical and chemical properties; malleability, etc.; potassium, sodium, etc., etc.

Algebra.—Literal equations; equations of the second degree; problems.

Physical Exercises.—Gymnastics, swimming, etc.

THIRD YEAR.

Compulsory Courses—Commercial Bureau.

Practical Bureau.

Each of the pupils, or a group of two, represents a commercial house established in a Swiss or foreign port, and chosen specially, according to the branch of commerce which the pupil proposes to enter upon leaving school. The commercial papers and quotations of the different towns are received regularly. The pupils make offers of service to one another, determine the cost price of the goods by taking into account the exact conditions of transport and insurance, as well as Customs dues, etc.; undertake business in conjunction with others, either for commerce proper, or for banking business, etc.

Each one keeps the books and carries on the correspondence of the house represented.

Theoretical Bureau and Mathematics applied to Commerce.

Precious Metals.—Quotations of the chief places. Accounts of purchases and sales.

American Book-keeping.—Opening and closing of accounts of companies (limited, joint stock, etc.), consignments, accounts in foreign moneys, etc., progressions; logarithms; compound interest. Redemptions of loans by sinking funds.—(This part is dealt with in the algebra lessons).

Commercial Law—

A. General ideas on law and its various branches; public and private law; Commercial law; sources of law, etc.

B. General ideas on obligations.

I. Their nature; formation (particularly by contract; nature; forms and conditions of contracts); their effects (performance; failure of performance); extinction; special obligations (joint and several, conditional); earnest, forfeiture, and penal clause.

II. The Merchant.—Definition; commercial register; commercial books; civil capacity.

III. The Merchants' Assistants.—Engagement, etc.; commercial employees; private attorney; commercial representatives and travellers.

IV. Commercial Companies.—

A. General ideas on Company Contract; companies with or without juristic personality; non-commercial societies.

B. Different companies or societies; simple companies; syndicates, etc.; joint stock companies, etc.; partnership.

V. The Principal Commercial Contracts.—Selling and exchange; transmission of personal property; assignment of debts; pledge; right of detention; warehouses; loan; assignability; letter of credit, etc.; commission; transport.

Political Economy.—Aim; wealth.

Production; machinery and factors; nature; labour, its organisation; associations; corporations; professional syndicates; trusts; strikes; monopolies; competition.

Division of labour, its forms, advantages and disadvantages.

Saving; capital.

Machines: their influence on industry and the condition of the working classes. Production on a large scale.

Distribution of wealth; property; income; interest; profit and wages; participation in profits.

Comparison of the production and distribution of wealth with the population; Malthusian theory.

Brief ideas concerning the Circulation and Consumption of Wealth.—Exchange; value; money; credit; commerce; insurance; finance.

Commercial Geography—

America; Asia; Africa; Oceania. Repetition as in second year.

Economic and Commercial Geography.—Mining centres; parts of the world producing foodstuffs and raw materials exported to Europe.

Inter-oceanic and transcontinental routes; colonisation; economic future of countries not yet sufficiently exploited.

Tables of statistics, with diagrams, etc., as in second year.

French.—

French.—Literary compositions; accounts of passages read; improvisations; literature of 17th and 18th centuries; grammar; dictation; etc.

Stenography (for French pupils).—Study and practice of all the abbreviations of professional stenography.

Chemistry.—Organic chemistry; object of organic chemistry; atomicity of the carbon atom; graphic formulæ—chains, rings; homologous series; empirical and constitutional formulæ.

Fatty or Aliphatic Series.—Hydrocarbons—Methane; ethane; petroleum; etc.
Derived Halogen Compounds.—Chloroform; iodoform.
Alcohols (Definition).—Methyl, ethyl, amyl alcohols; glycerine; etc.
Carbohydrates.—Glucoses; sugars.
Sulphurous ether.
Organic Acids.—Natural state; formic; acetic; palmitic; stearic, etc.; oxalic; succinic; tartaric; citric; lactic; etc.
Cyanogen Compounds.—Hydrocyanic acid, etc; Prussian blue.
2. Aromatic Series.—Benzol; nitrobenzol; aniline; aniline colours; phenol; picric acid; salicylic acid; tannic acid; essential oils; essence of terebenthine; caoutchouc; gutta-percha.
Alcaloids.—Morphine; quinine, etc.; ptomaines; toxines.
Albuminoids.—Albumen; fibrin; casein.

Study of Commodities—
Textile Fabrics.—Silk; wool; cotton; hemp; flax; jute; &c.
Spun and woven goods.
Coffee; tea; cacao; coca.
Spices and Aromatics.—Pepper; allspice; clove; cinnamon bark; aniseed; mustard; ginger; etc.
Sugar; resins; tobaccos; wax; candles; soaps; paper; dyeing materials (vegetable and animal); alimentary preserves; cereals; alcoholic drinks (wine, beer, &c.); vinegar; milk; animal products—bone, horn, shell, ivory, skin, feathers, hair, &c.; manures; precious stones.

Physics.—Properties of matter.
Mechanics.—Motion, uniform and uniformly accelerated; Composition and decomposition of forces, etc.
Weight.—Centre of gravity, pendulum, etc.
Hydrostatics and Pneumatics.—Pascal's principle; Hydraulic press, etc.
Heat.—Temperature, thermometers, &c.; Fusion, distillation, etc. Steam Engines.—Propagation of heat, etc.
Optics.—Reflection and refraction of light; Lenses and mirrors, etc.
Magnetism.—Magnets, compass, etc.
Static Electricity.—Fundamental electrical phenomena; Conductibility; Electric power; Power of points; Electroscopes; Electrical engines; Different effects of electricity, etc.

A Foreign Language.—French pupils must take German as well as a second foreign language.
Lectures.—The students are compelled to deliver an address in French of half an hour's duration at least, and one of a quarter of an hour in each of the languages studied.
Each lecture is followed by a serious criticism, and the lecturer is questioned by those present on the fundamental theme of his work. The criticism and chat which follow are carried on in the language employed by the lecturer.
Algebra.—Compulsory for those desirous of promotion to the fourth year.

Optional Courses.

Foreign Languages.—German, compulsory for French students. English, Italian, Spanish, Russian.
General Programme.—(*a*) Syntax, idioms, dictation, etc; (*b*) Reading of selected passages; conversation on these; accounts of passages read; commercial terminology, etc. (*c*) Commercial correspondence.

German.—For German students. Advanced course of reading; Composition and lectures.

Caligraphy.—Revision; Cursive, round, Gothic; Commercial documents; Exercises in running hand; Simple monograms, etc.

Stenography—German Students. Stolze-Schrey system. Study of all the rules of shorthand; exercises in continuous work, speed, &c. Manual, R. Schwarz. Exercises by S. Alge.

Dactylography (Typewriting):—In addition to the regular lessons, provision is made for practice under the supervision of the teacher.

Study of Adulterations:—Microscopy; practical work in laboratory.
Study of the composition and adulterations of the alimentary beverages and foods, as well as of the principal commodities; fermented drinks: brandy, liqueurs, alcohols; farinaceous foods: bread, milk, butter, cheese; fats and oils: fruit and vegetable preserves, coffee, tea, cacao, vinegar, sugar, honey, spices, soaps, petroleum, noxious and innocuous colours.

Textiles:—Silk, wool, cotton, &c.

Each lesson will embrace a theoretical account of the subject to be studied, and then the practical work, comprising:—

(*a*) In chemistry: The analysis of pure and adulterated substances.
(*b*) In microscope work: The preparation of substances to be studied; the mounting of the microscopical preparations; the analysis; photomicrography.

The students may choose the subject they desire to study specially.

Algebra:—Compulsory for those desirous of promotion to the fourth year; progressions, logarithms, &c.

Physical Exercises:—As before.

FOURTH

FOURTH YEAR.

Compulsory Courses.

Bureau Commercial.

Annuities and Redemption of Loans by Sinking Funds:—Formulæ and tables of compound interests; general theory of liquidation; constant and variable annuities; liquidation of loans by bonds with or without lottery; tables of sinking funds.

Arbitrated Exchanges:—Study of the chief exchange prices and of the way they are quoted; conditions of purchase and sale of the principal articles of commerce in the leading commercial centres; study of current prices; calculations of prices, of exchange, of public stock, and of precious metals.

Insurance:—Elements in the calculation of probabilities, its application to the study of the laws of human mortality; tables of mortality; probable life; average life; practical study of insurance contract and of the general conditions of policies.

Endowment Assurances.—Annuities—immediate, temporary, deferred.

Assurances for Life—Joint Assurances.

Computation of Premiums—Single and Annual premiums.

Mathematical Reserve—Reduction and repurchase. Control exercised in Switzerland upon insurance operations. Study of the reports of the Federal Bureau. Book-keeping of Insurance Companies. Study of the balance-sheet of the principal societies operating in Switzerland.

Transactions in Public Funds and Goods. Commercial and Stock Exchanges, Gambling and Speculation.

Clearing Houses.—Practical study of their function. Carrying forward.

Different Systems of Book-keeping.—Industrial, financial, private, public—budget. Control and revision of accounts.

The Slide-rule and calculating machines.—Practical Bureau.

Commercial Law.—The subjects treated in this course, particularly in the 2nd and 3rd parts, will be presented in the form of a clear and practical *résumé* of what the merchant should know. The exposition of the different subjects will be accompanied by practical work, in which the students will be called upon to discuss with the teacher, and to solve cases drawn from commercial life. Moreover, the teacher who has charge of the bureau will take his pupils to the Cantonal Tribunal, where interesting points of a commercial or industrial character will be pleaded and adjudicated upon.

1st. Section.—Proceedings in case of debt and insolvency. Nature and organisation of prosecution for debt.
Methods of Procedure.—Seizure, realisation of the security, ordinary procedure by way of insolvency and prosecution for bills of exchange. Assets and Liquidation of the Estate. Composition—Bankruptcy. Sequestration and compulsory restitution.

2nd Section.—Commerce and Industry in their relation to the public and administrative law.

i. General ideas on public and administrative law. The State and the principal forms of Government.

ii. The representation of commercial interests abroad.—International relations. Treaties concerning the conducting of houses of business. Diplomatic and Consular agents. Chambers of Commerce.

iii. The Customs and Commercial treaties. Legislation in the Customs.—The different tariffs. Free Ports. Certificates as to Origin of Goods.
Drawbacks, &c. Contravention of Customs. General ideas on commercial treaties. The principal commercial treaties between Switzerland and Foreign countries.

iv. The liberty and restrictions of commerce and industry.
  A. The principle of the liberty of commerce and industry, and its applications.
  B. The restrictions placed upon this principle.—1. Monopolies. 2. Police measures to safeguard the public interests. 3. Legislation on apprenticeship. 4. Legislation on factories, with appendix; Civil responsibility. 5. Patent fees. 6. Guarantee and control of the title of gold and silver works; trade in gold and silver dross.

v. Commercial Jurisdiction; Ordinary tribunals; Commercial tribunals; Arbitration tribunals; Councils of men and masters for settling disputes.

3rd Section.—

i. Principles of Common Civil Law; Rights of individuals and of family; Civil status, domicile, absence, marriage, matrimonial status, &c., paternal authority, guardianship; right of succession.

ii. Real rights.—Property, usufruct, servitude, mortgages.

iii. Reports on the Civil right of Swiss natives settled in foreign countries or in a canton other than that of their birth; reports on the civil right of foreigners in Switzerland.

Industrial Law.—Industrial property: its status in Switzerland from the national and international point of view; Patents: Industrial plans and models; Manufacturing or commercial private trade marks; Commercial name; False information concerning production; Usurpation of industrial rewards; unfair competition.

Railway

Railway Law.—The transport of goods by railway.

I. General ideas on transport contract; nature; conclusion, &c.

II. Internal transport of goods by rail.—A. Swiss Legislation: The federal law of the 29th March, 1893, and the regulation concerning transport of the 11th December, 1893. B. Brief sketch of the legislation of the principal neighbouring States.

III. International transport of goods by rail; the Berne Convention of the 14th of October, 1890; the Central Office.

Political Economy.—Internation exchange: its Theory; History of the doctrines relating thereto; Protection and Freetrade; Contemporary customs policy; Commercial treaties; Autonomous tariffs; Double tariffs.

Transit; Specific duties; *Ad valorem* duties; Sliding scale; Custom statistics.

The Mint: its functions, history; different species of money; Mono and bi-metallism; contemporary monetary systems.

Present distribution of wealth.—Interest, wages, income, and profit; Possible changes; Sketch of contemporary socialism.

Public Finances.—Expenditure and revenue; Critical study of the different duties; on public debt; loans; conversions.

Works and discussions on economic and social questions.

Commercial Geography.—This course constitutes a synthesis of the courses on the commodities and commercial geography of the previous classes.

Review of economic and commercial geography; special study of each of the chief marketable products; raw materials and manufactured objects, according to the following programme:—

Productions of the different countries compared; important outlets for trade; routes traversed by these products in passing from producer to consumer; quotations of the different markets.

Comparison of the principal ports, their maritime and commercial life; comparison of the merchant fleets of the different countries.

As in the preceding classes, lantern slides and diagrams are employed for the purposes of illustration.

French.—Literature of nineteenth century; life and works of chief writers.
Supplementary course for foreign students.
Literary compositions, improvisations, etc.; Grammar, synonyms and homonyms.

Physics.—Dynamical electricity; piles, electric current, etc.; physiological, chemical effects, electrolysis; voltameter, etc.; application of electrolysis to industry and metallurgy; electric syntheses, physical effects of currents, etc.; induction, dynamos, transmission of power, electric light, telephone, telegraph, electric bells.

A Foreign Language.—German compulsory for French students as well as a second foreign language.

Lectures.—The students are compelled to deliver a lecture in French of one hour's duration and one of half-an-hour in each of the languages studied.

Criticism as in third year.

In all the language courses, an additional hour a week is devoted specially to preparation for the lectures.

Every year the School Committee arranges for a number of lectures by specialists on questions of the day. All the pupils of the fourth year are compelled to attend.

Optional Courses.

German.—As before.

English, Italian, Spanish, Russian.—(*a*) Revision of Syntax, etc. (*b*) Reading and interpretation of authors; *résumés* and accounts of passages read; reading of commercial newspapers and works, etc. (*c*) Composition; commercial letters; reports presented orally or in writing on some commercial question; discussion.

German.—German students: modern German literature; reading of authors, as Liliencron, Sudermann, etc.; lectures and discussions.

Geographical Current Events.—Study of geographical questions of the day and of events tending to modify the respective situation of the different nations, with special emphasis on the economic consequences of these events:—

European and American colonial expansion; The English in the Soudan—the partition of Africa; The Chinese question and Russia's aims in Asia; Fields of future colonisation; Trans-Siberia; South Africa—English and American Imperialism; Industrial and commercial expansion of the United States—Trusts—Japan—Bagdad Railway—The Persian Gulf—International disputes beyond Europe—The Transvaal—Newfoundland and the fisheries—Pan-Americanism—Australian Federation.

Gold-mines (Klondyke, Transvaal) and their influence on emigration.

Study of fresh geographical facts and accounts of the chief explorations in course of progress.

Questions connected with the conflict of races and languages in Europe will be treated in the course on contemporary history.

Contemporary

Contemporary History—

French Revolution—its consequences; the Empire—Europe in 1815—Restoration; Revolution, 1830—Europe, and specially Switzerland, from 1830 to 1848; Revolution of 1848; Second Empire.

The Eastern Question.—Crimean War; England and Russia in Asia; Italian unification; German unification—War of 1870-1871; The Commune—Peace of Frankfort.

Contemporary Europe:—

Leading Countries.

France: Thiers and Gambetta—Constitution of 1875; Struggle between MacMahon and Parliament—Various crises (Boulangism—Panama—Anarchistic outrages); Arrangement of parties—Protectionist movement; Franco-Russian Alliance—Colonial Policy.

Germany: Organisation of the Empire; Question of Alsace and Lorraine—Struggle with the Socialists; Bismarck and William II; The Triple Alliance; Colonial expansion.

Austria-Hungary: Conditions of political life in the Monarchy and its different parts—The compromise—Territorial expansion (Bosnia and Herzegovina); Party struggles and coalitions; Electoral reform; Struggle between the different languages.

Italy: The Council of 1870, and the Laws of Guarantees—Victor Emanuel II and Pius IX—Humbert I and Leo XIII; The Triple Alliance and Crispi; Present political and economic condition; Colonial undertakings.

Great Britain: Home Rule; Gladstone and Salisbury; Liberals and Unionists; Socialists; Imperialistic policy, conflicts, territorial aggrandisement.

Russia: Alexander II—Eastern war; Berlin Congress; Nihilism—Alexander III, his policy; the Kronstadt interview—Nicholas II—Poland—Finland—Religious policy—Territorial expansion—Great Britain and Russia in Asia.

The Ottoman Empire: Young Turkey; Russian invasion and dismemberment; Abdul Hamid; Egyptian, Armenian, Cretan questions.

Greece.—George I; The Parties; Greco-Turkish War.

Balkan States.—Roumania; Servia; Bulgaria.

Spain.—Reign of Amadeus; Republic; Restoration of 1874; Constitutional Monarchy, Party struggles; Republicans and Carlists; The Spanish-American War; Loss of Colonial Empire.

United States.—War of Secession; The Parties and their programmes; Economic policy; Policy of Expansion.

Spanish-American Republics.—Outline of the political, economic, and social condition; Wars (Peru and Chili) and Alliances; Brazil; Fall of the Empire; The Republic.

The Smaller Countries.

Belgium.—Party struggles (Catholics, Liberals, and Socialists); Electoral reform; The Congo.

Holland.—Party struggles; Socialism; Colonies.

Switzerland.—The Neutrality of 1870–71; Constitutional revision of 1874; The Parties and their programmes.

Denmark.—The Constitutional struggles; Foreign policy.

Sweden and Norway.—The Parties; Antagonism between the two countries.

The Extreme East.—Japan, China, Korea; The war between China and Japan; Dismemberment of China.

The Hague Conference and the present political situation.

Caligraphy.—Revision; Cursive, etc.; Roman. Composition of titles, advertisements, announcements, handbills, monograms, etc.; exercises on the blackboard.

Stenography.—Practice in speed.

Dactylography (typwriting).—As in 3rd year.

Study of adulterations, microscopy, practical work.

(2.) Modern Language Section.

Preparatory Class.

The pupils of this class (always few in number), are divided into small groups according to their nationality or their knowledge, an arrangement which makes the instruction almost individual; they are engaged in the study of French for twenty-four hours each week. As soon as they are sufficiently advanced, they may take up other courses, and when their preparation is judged sufficient, they are enrolled in the division most adapted to their age and fitness.

The preparatory class being designed merely for new-comers, each pupil spends but a comparatively short time in it, varying from some weeks to some months.

The teacher entrusted with the instruction in this class speaks, in addition to French, German, English, and Italian.

Lower

Lower Division.

All the courses are optional: Minimum number of hours=32 a week.

French.—Study of words; conversation; complete study of the grammar, with practical exercises; orthography; written and oral accounts of passages read; composition; commercial correspondence; improvisations; reading of passages; recitations; pronunciation.

Foreign Languages.—German; obligatory to French students; English; Italian; Spanish; Russian.

Complete revision of the grammar; study of the formation of words; translations from and into the foreign languages; dictation; reading and interpretation of modern authors; vocabulary; recitations and improvisations; composition.

This course follows on that of the second year of the Commercial School; the students who are insufficiently prepared are allowed to follow the lessons in foreign languages of the first and second years of the commercial classes.

Arithmetic.—Recapitulation of vulgar and decimal fractions; metric system; surfaces; volumes; rule of three; interest and discount; proportional parts; mixtures; alligation.

Book-keeping.—Characters of book-keeping by double entry; current operations of a commercial house entered in the day-book and ledger; balancing; inventory; opening and closing of accounts; practical ideas on bills.

Geography.—Ideas of cartography; reading of maps; minute study, made on the land itself, of a map to a scale of 1 to 25,000 of the Siegfried atlas; neighbourhood of Neuchatel.

Physical Geography.—Oceans and continents; development of the coasts; relief of the land; river basins; climates and natural production.

Political Geography.—Expansion of races; study of the principal countries of the world; industrial and commercial cities; ports and colonies.

Caligraphy.—Position of the body; holding of pen; commercial writing; cursive and round; minute study of the capitals and small letters; figures; headline and address of a letter; visiting, address, and announcement cards.

Stenography (German).—Stolze-Schrey system; study of the chief rules of shorthand; reading; dictation.

Upper Division.

The principle of classes numerically small and composed of homogeneous elements will be applied with special emphasis to this division, in which the School Committee is resolved to keep those pupils alone who are desirous of improving themselves, and who are determined to address themselves most seriously to the work.

The Director may authorise the pupils of this division to take the French lessons only; this authorisation will only be granted in cases that are quite exceptional, and may be withdrawn at any time, particularly if the pupil to whom the concession has been made, does not show himself worthy of it by his work and conduct, as well out of, as in the school itself.

Programme—All the courses are optional; minimum number of hours = 32 a week.

French.—Composition and derivation of words; homonyms; synomyms; Gallicisms; full revision of the grammar with practical exercises; orthography, etc.; history of contemporary French literature.

Foreign Languages.—German, as before; English; Italian: Spanish; Russian.

General programme.—Syntax; extempore work; dictation; reading and interpretation of authors; translation of French authors; lectures and discussions; history of literature. Students insufficiently prepared are allowed, etc. (*See* Lower Division.)

Arithmetic.—The same as in Lower Division.

Book-keeping.—*See* Lower Division.

Geography.—*See* Lower Division.

Caligraphy.—*See* Lower Division.

(3.) Post and Railway Section.

The courses last from the 15th September to the 15th April, and are organised on essentially practical lines, conformably to the demands of the postal and railway services.

French.—French students—Grammar and orthography; compositions amd improvisations—recitations.

Foreign students—Study of words and exercises in conversation; full study of grammar; orthography, etc.; composition and oral accounts of passages read; reading of modern authors and pronunciation; recitations and improvisations—Gallicisms.

Foreign Languages.

German.—Compulsory for French students—Recapitulation of grammar—syntax; translations from and into the languages studied; translations in accordance with the "Index of the Orders of Service"; oral exercises on subjects treated.

Oral or written reproduction of passages read or related; composition; correspondence.

German.—German students—Translations; composition on subjects chosen by the students or on their own private reading: oral expositions.

The Classics, with reading and interpretation of chosen passages.

The students are allowed to follow the courses in English, Italian, Spanish, and Russian, of the Commercial School, so far as the time-table will permit.

Arithmetic

Arithmetic.—As for Modern Language Section.

Special Arithmetic.—Practical exercises in connection with the whole programme of the ordinary arithmetic course, designed to give greater skill and accuracy for the commonest calculations.

Subjects treated more specially.—The four operations with whole numbers; decimal and vulgar fractions; tables of addition with verification (monthly results); coins of the different countries of the Postal Union; turning of these coins into francs; abridged multiplication; special study of English coins. Numerous exercises in mental arithmetic.

Special study of the principal postal regulations and tariffs—Railway tariffs; telegraphic rates; telegraphic codes.

Geography.—*See* Modern Language Section for general, political, and physical.

Special Geography.—Switzerland—Relief of the Land; hydrography: minute study of each canton, important localities; industry and commerce; imports and exports.

Railways and Navigation.—Railway systems of the different companies; junctions, and chief stations; junctions with foreign lines.

Railway lines which bring Switzerland into communication with the chief ports and the most important cities of foreign countries; principal lines and great railway companies of these countries; internal and river navigation.

Connection with over-sea countries and the chief lines of these companies; inter-oceanic lines and great shipping companies.

Post and telegraph offices; postal districts; Alpine routes.

Universal postal union.—relations with foreign countries; routes followed by postal packages and correspondence; telegraphic union; transmission of telegrams; great telegraphic lines; maritime cables.

Practical work.—Imaginary journeys in Switzerland and abroad; indication of the route to be followed and the chief stations, especially the stations where the customs formalities must be undergone, as well as the companies whose lines are being used; approximate duration of journey; number of kilometres traversed; approximate fare.

Transmission of telegrams, of postal packages or correspondence; route to be followed, and time necessary for reaching destination.

Caligraphy.—Cursive, etc.; figures; headlines, etc.; postal documents; copies and dictation; running hand, etc.

Stenography:—

For French students.—Aimé Paris system; positive stenography and first abbreviations.

For German students.—Stolze-Schrey system; study of the principal rules of shorthand; reading; dictation.

PROGRAMME OF COMMERCIAL SCHOOL, NEUCHATEL, FOR FEMALES.

General Organisation.

The Commercial School provides for a four years' course.

During the first two years, the female classes are completely separated from the male classes and receive their lessons in a special building. In the third and fourth years the classes are combined at the present time, but provision is made for their separation as soon as the number of female students is sufficient.

The programme of the first two years only is given here; for the other classes, *see* the complete programme of the Commercial School.

Upon finishing their second year a "Certificat d'Etudes" is given to the students who have fulfilled the conditions fixed by special regulation.

Conditions of Admission.

Vide Complete Course.

Fees.

The fees are fixed at 90 francs a year, payable as follows:—

30 francs at the commencement of the school year.
30 francs at the beginning of January.
30 francs in April.

The fees for the Preparatory Course are 30 francs; for the Holiday Course, 30 francs also.

Programmes.

For the Preparatory and Holiday Courses, *see* Complete Course.

Commercial School.

Commercial Bureau.—*See* Complete Course.

Additional Book-keeping.—Cash-book, stock-book, household book-keeping; copying of letters; bills and invoices; postal tariffs; principles of commercial correspondence.

Arithmetic.—Vulgar fractions and decimals; metric system; areas; volumes; rule of three; interest and discount.

Computation of interest at 6 per cent., and the fixed divisor; application to the discounting of bills; memoranda of Swiss bills; tariffs of Swiss stamps; abridged methods of multiplication and division. Mental arithmetic: exercises on the various parts of the arithmetical work.

French.

French.

For French students.—Grammar and orthography; compositions and improvisations; narratives and recitations; style and figures of speech; literature of the 17th and 18th centuries.

For Foreign students.—*See* Complete Course.

Stenography.—For French pupils (*see* Complete Course).

A Foreign Language.—*See* Complete Course.

Optional Courses.

German, English, Italian, Caligraphy, Stenography.—*See* Complete Course.

Commercial Geography.—*See* second year of Complete Course.

SECOND YEAR.

Compulsory Courses.

Commercial Bureau.

Practical Bureau.—*See* Complete Course.

Theoretical Bureau and Commercial Arithmetic:—Except in a few particulars this part of the course is identical with that of the second year of the Complete Course.

French—for French students.—*See* Complete Course.
Additional:—Style and figures of speech; literatures of 17th and 18th centuries.
For foreign students.—*See* Complete Course.

Caligraphy, Stenography, a Foreign Language.—*See* Complete Course.

Optional Courses.

German, English, Italian, Stenography.—*See* Complete Course.

Commercial Geography.—*See* third year of Complete Course.

Study of Commodities:—

Colonial Foods:—Coffee—its succedanea and adulterations; tea, mate, coca—method of preparation; cacao—manufacture of powdered chocolate and cacao; kola nut.

The Chief Spices:—Pepper, mustard, vanilla, &c.—their preparation and adulterations.

Sugar:—Sugar-cane and beetroot—manufacture.

Fatty Substances:—Candles, soaps.

Textiles:—
(1) Textiles derived from animals: wool and silk.
(2) Textiles derived from vegetables: cotton, flax, hemp, jute, &c.
(3) Spun and woven materials.

Dyeing materials—derived from animals and vegetables; Alimentary preserves: wine, beer, cider, liqueurs, milk, vinegar; Cereals: bread, rice foods, starch, glucose; Animal products: as bone, ivory, horn, shell, &c.; Mineral products: precious stones; glass and porcelain.

Common Law:—Rights and duties of childhood; majority and its consequences; marriage and matrimonial law; civil capacity of a married woman; some common contracts; hiring of services; leases; different insurances; different methods of investment; successions; testaments; rights of survival.

Dactylography (Typewriting).—Besides the regular lessons, the machines are placed in a special room for the use of the students to practise in their own time, under the supervision of the teacher.

Hours devoted each week to the different subjects.

Subjects.	Preparatory Course.		Holiday Course.		First Year.		Second Year.	
	French Students.	Foreign Students.	French.	Foreign.	French.	Foreign.	French.	Foreign.
Arithmetic	6	6	......	3	......	......	......	......
Book-keeping	6	6	......	3	......	......	......	......
Commercial Bureau	......	......	......	......	8	8	8	8
French	4	12	......	12	6	10	6	10
German	12	......	......	......	6	2	6	2
English	4	4	......	......	4	4	4	4
Italian	4	4	......	......	4	4	4	4
Caligraphy	2	2	......	......	2	2	2	2
Stenography	......	......	......	......	2	2	2	2
Dactylography (Typewriting)	......	......	......	......	2	2	2	2
Commercial Geography	......	......	......	......	2	2	2	2
Commodities	......	......	......	......	......	......	2	2
Common Law	......	......	......	......	......	......	2	2

CHAPTER LXII.

CHAPTER LXII.

Commercial Education in the United States, America.

[J. W. TURNER].

Introduction.—In providing a systematic general course of business and commercial training for its youths, the people of the United States, America, come very close to the high standards reached in Germany. Nothing in the way of specialisation is attempted in the Grammar Schools of the States, but the pupil, on being transferred to the High School, has a choice of courses, of which one includes commercial subjects. Every town of any importance has its High School, which may be either a purely classical institution, preparing its pupils for the College or the University, or, as is more frequently the case, a school with a modern as well as a classical side, insisting on a certain obligatory course, but allowing its pupils otherwise to choose their own subjects. In the High Schools with elective courses the equipment in the commercial and scientific sections is very superior.

Business Practice.—Model Houses.—Regarding the commercial section, the great feature of the teaching is the actual business practice which is carried on in the school. In all the newly-erected buildings a spacious room is fitted up to represent a model business house, with the necessary office accessories, to enable the students to carry on the usual routine of business. This preparation in business practice, peculiar to the United States, is conducted on a much greater scale in the business colleges, which are attended by youths older than those of the High Schools. The organisation of the business colleges of America is described in the following extract from a paper read by Mr. Bernard de Bear at the International Congress on Technical Education, held at the Society of Arts, in 1897:—The great feature of these colleges is in the actual business practice. After having completed a certain amount of theoretical work, the student is advanced to the counting-house department, which is a realistic representation of a business house. Indeed, in the larger institutions one would find an entire floor of the college building fitted up with, here a counting-house, there a bank, with its different divisions; and in other parts of the hall, offices representing firms of various descriptions. The student then actually performs in turn the duties of salesman, shipping clerk, cashier, receiving clerk, bill clerk, stenographer, book-keeper, &c."

Views of German Director on Model Business Houses.—The Committee on Commercial Education, referred to in the beginning of this report, condemns the model business house with its store or office fittings, and the latest views of a German educationist are opposed to it as a part of commercial training. Speaking at the Fourth Congress of the German Society for the development of Commercial Education, at Mannheim, January, 1903, on the question of model commercial offices, Robert Stern, Esq., Commercial High School, Leipzig, expressed himself as opposed to the teaching of commercial ideas by the medium of model offices fitted up in schools, considering that while pupils learnt a lot of routine work they gained but little thorough knowledge. He disapproved of the imitation in the school of the interior office work of a business establishment, which was, in his opinion, of problematic value on account of the great many different practices in use in the various branches of business. He was firm in his belief that if pupils were taught the principles of commercial teaching they would in practice readily acquaint themselves with the organisation of the different business branches. The school, he said in conclusion, will never replace practical experience, nor turn out finished business men.

The question of commercial practising offices is one which, among educational committees at the present time, is receiving a great amount of consideration. Its importance may be judged from the fact that Mr. Stern was specially appointed at a previous congress to investigate the subject.

Evening Classes for Commercial Instruction.—The lad who leaves school on the completion of his Grammar School course to engage in work has opportunities for attending evening classes in the High Schools, and many of the privileges for improvement offered to the more fortunate day-school boy or girl are within reach of the boy or girl who has to work during school hours. The teachers of the evening schools are just as enthusiastic as the day-school teachers, and the work is carried on with equal intelligence. Such was the experience of the Commissioner when visiting several evening commercial classes in the High Schools of America.

As typical of the commercial teaching in the High Schools of America, the course of the Detroit High School is quoted, and a description of the Commercial School, San Francisco, which is devoted exclusively to training for business, is furnished.

Detroit High School (Day Course).

The course of study in Detroit High School follows on from the completion of the 8th grade in a Grammar School course, generally about the age of 14 years, and extends over four years, known as grades 9, 10, 11, 12. (It must always be remembered when speaking of Grammar Schools of the United States of America that these institutions are Upper Elementary Schools, attended by pupils from 10 to 14 years of age, grades 5 to 8, inclusive. The Primary schools are the Lower Elementary Schools attended by pupils from 6 to 9 years of age, grades 1 to 4, inclusive.) The school work includes all the branches usually taught

taught in High Schools, and the subjects are divided into compulsory and optional. The following subjects are compulsory for all courses:—English in every year, algebra and history in the first and second years, geometry in the third year, and physics in the fourth year. From the elective studies enough work must be offered to make up the marks necessary for the graduation certificate. The commercial work is distributed over the four years. Thus, in the 9th grade or first year in the school, book-keeping and geography are taught; in the 10th grade, or second year, book-keeping and phonography are taught; in the 11th grade, or third year, book-keeping is dropped and typewriting and commercial geography or civics and commercial law are introduced, while phonography still remains on the time-table; in the 12th grade, or last year in the school, economics and phonography complete the programme. French and German run throughout the entire course; biology in the second year only; chemistry in the third year; book-keeping gets five lessons each week throughout the first and second year; phonography five lessons each week during the second year and two and a half lessons each week during the third and fourth years; typewriting gets two and a half lessons in the third year; commercial geography or civics, commercial law, physics, and economics receive five lessons per week during their respective terms. The following syllabus of studies will give some idea of the commercial training given to the pupils of this school.

Commercial Studies.

Book-keeping.

Course for 9th grade, first half-year.—Instruction in opening a set of books, journalising, posting, taking trial balances, making statements for determining the condition of the business, closing the ledger. Exercises in drawing up all kinds of commercial papers, depositing money in bank and withdrawing therefrom, keeping an accurate account of the same. Partnership business introduced, sales books used, monthly statements rendered and collections made.

Course for 9th grade, second half-year.—Introduces use of cash book (both single and double entry), and the special column journal, with method of posting from each. Single entry is introduced, with instructions for determining the condition of the business and closing the ledger.

Course for 10th grade, first half-year.—Commission business introduced with use of commission sales, ledger, special column cash book, making shipments, receiving consignments and rendering account sales of same. Actual business practice is now taken up in which the pupils carry on all business transactions among themselves and with properly equipped business offices, consisting of a bank, jobbing and commission house, general mercantile company office, and merchants' express company. New forms of books used, four-column journal, and sixteen-column automatic journal. Balance sheet used.

Course for 10th grade, second half-year.—Sixteen-column automatic journal continued, voucher system of book-keeping introduced in a manufacturing set. Pupils at this point are put in charge of the several business offices, in which they are held responsible for proper conduct of the office and the submitting of the books, with correct trial balances for approval, once a week, to the teacher in charge. Ten weeks are required for this office practice.

The offices are all equipped with modern blank books adapted to the needs of the business which they represent. Neat, accurate, and thorough work is required throughout the several courses, and with the business-practice feature brought as near to real business experience as may be, outside of a business office, the graduates of this department are fully qualified to successfully make their own way in the business community, having had all the advantages of purely educational studies along with the commercial branches.

Commercial Law.

Text: Spencer's "Manual of Commercial Law."

The following is an outline of the principal topics taught:—Nature, source, and classification of laws in general. Contracts, treating of offer and acceptance, consideration, competent parties, contracts that must be in writing, etc. Commercial paper. Agency, how formed; authority of parties, how terminated. Partnership, formation, powers and responsibilities of partners, dissolution. Limited partnerships. Corporations, nature and formation, management, corporate powers, liability of stock-holders, dissolution and winding-up. Sales of personal property. Mortgages of personal property. Bailments, gratuitous and mutual benefit. Pledge or pawn. Common carriers, liabilities and duties. Guaranty and suretyship. Fire, marine, accident, and life assurance. Shipping. Real property, estates in, titles to, mortgages of. Landlord and tenant.

The above work is supplemented by exercises in drawing up the more common forms of legal papers, such as deeds, mortgages, land contracts, leases, bills of sale, etc.

Economics.

Text: Ely's "Outlines of Economics.'

The following topics are treated in recitations, talks, and discussions:—

1. Historical survey of the growth and development of economics.
2. Private Economics.—Production; factors of, and the organisation of the productive factors. Transfer of goods; origin and organisation of exchange, money and its varieties, bi-metalism, credit. Distribution; with and without free land, wages, the labour movement, profit sharing and co-operation, interest and profits. Consumption; consumption and saving, luxury, harmful consumption, analysis of consumption.
3. Public Economics.—Public industry and the relation of the State to private enterprise. Public expenditures. Public revenues—miscellaneous sources of revenue, taxation, public debts.

Phonography.

Text-book used: Graham's "Hand-book of Standard Phonography."

The course of study in phonography contemplates the training of the student to act for himself under clearly conceived principles. This will be regarded as of fundamental importance.

Organisation

Organisation.—The Detroit High School has accommodation for 1,700 pupils, the sexes being educated together. The building is new and of modern design; it is in a good open position, and is an ornament to the city. The internal arrangements are very fine. The building is of three stories, and is provided with two large elevators of the newest principle. It contains a large central hall; wide corridors; four spacious class-rooms, in reality school-rooms, with adjoining recitation rooms for class teaching; an auditorium capable of holding 1,700 pupils; science rooms, well supplied; large reading hall; splendid library; slate panels let into walls, used as blackboards, in all class-rooms; banking compartment, admirably fitted up for commercial practice; and furniture of the most approved type throughout. The ventilation, lighting, and heating are all on the most hygienic principles. The site and buildings cost upwards of £100,000. The school has three sides—classical, scientific, and commercial.

The Commercial School, San Francisco.

Organisation.—The Commercial School in San Francisco, under the Department of Public Instruction, is given up entirely to training boys and girls for business pursuits. The sexes are taught together, the girls greatly preponderating, and the attendance is about 500. The course extends through two years. The admission is on the Grammar School certificate. The daily hours of instruction are 9 to 12 morning, 1 to 3·30 afternoon. The only modern language taught is Spanish, and 50 per cent. of the pupils are learning it. The merchants of San Francisco carry on trade with several South American ports where the Spanish language is used, and hence the necessity for teaching Spanish in the Commercial School A similar state of things was noticed in the Royal Academical Institution, Belfast (a higher Secondary School), in which there is a tendency to exclude German from the curriculum and put Spanish in its place, on account of the trade that has sprung up between Belfast and South American ports. There is nothing in the Commercial School at San Francisco to compare with the banking compartment of the High School at Detroit, and no comparison can be made between the two buildings; but the former school has a splendid teaching asset in the shape of 100 typewriting machines, all in regular daily use.

Course of Study.—The course of study is as follows:—

First Half-year.

English	4	recitations per week.
Commercial Geography	4	,,
Business Arithmetic	4	,,
Book-keeping	4	,,
Stenography	4	,,
Typewriting	4	,,
Penmanship	2	,,
Spanish (elective)	4	,,

Second Half-year.

English	4	recitations per week.
American History	4	,,
Business Arithmetic	4	,,
Book-keeping	4	,,
Stenography	4	,,
Typewriting	4	,,
Penmanship	2	,,
Spanish (elective)	4	,,

Third Half-year.

English and Rhetoric	4	recitations per week.
Civil Government	4	,,
Business Arithmetic	4	,,
Book-keeping	4	,,
Stenography	4	,,
Typewriting	4	,,
Penmanship	2	,,
Spanish (elective)	4	,,

Fourth Half-year.

English and Rhetoric	4	recitations per week
Commercial Law	4	,,
Business Arithmetic	4	,,
Book-keeping	4	,,
Stenography	4	,,
Typewriting	4	,,
Penmanship	2	,,
Spanish (elective)	4	,,

Syllabus in Mathematics.—The following is the syllabus in Mathematics:—The chief objects are: To give the pupils correct conceptions of numbers and of their relations; to teach them to think clearly; to express themselves accurately; to make them accurate and rapid in commercial computations (especially Addition, Multiplication, Bill Extension), and the usual business applications of the principles of Percentage, Trade Discount, and Interest, aiming at accuracy and rapidity. All operations and processes taught are associated and compared with others previously given, based upon the same principles.

Much attention is given to mental work, pupils being taught to use as few figures as possible—mental exercises with small numbers generally preceding and always accompanying written exercises. Logical analysis is constantly used in explanation. The pupils are required to express themselves frequently and in accurate language, illustrating processes by means of objects, and comparing each new number with preceding ones.

Much attention is given to investigating and applying the practical methods of business computations used by representative business houses in San Francisco, the pupils being thereby not only properly informed and drilled, but also induced to take an interest in their work on account of seeing its practical application to daily business life.

First Year.

Junior A.—Correct and rapid addition, pupils adding by units and thinking only of sums of units, never repeating tens. Daily drill in adding one, two, three, and four columns at a time; in adding vertical and horizontal columns, totals being always written according to Civil Service method. Mental drill, subtracting and adding four columns at a time.

Short and rapid multiplication. Daily drill in writing bills and statements. Bill extension by methods of aliquot parts, and of addition, chiefly by tens and eights, specimens of methods of representative business houses used as examples. Commercial or trade discount. Drill in finding difference in time between dates accurately and rapidly, months being numbered, and much of the work being mental. Use of the "System of Nines," and other checks and methods of rapid calculation. Home-work, problems neatly solved and arranged.

Junior B.—Repetition of and continued drill in work specified in Junior A. Percentage and interest. Interest chiefly taught by sixty-day 6 per cent. method, but bank, day, month, and year methods also taught. Drill in changing from ordinary to accurate interest, and *vice versa*; in discounting interest and non-interest bearing notes. Bank and true discount. Lumber measure and calculation, according to method of San Fransico lumber men.

Second

Second Year.

Senior A.—Repetition of and continued drill in work of first year. Partial payments; U.S and mercantile rules; compound interest; equation of payments and accounts; commission; profit and loss; exchange, chiefly domestic; thorough drill in writing of business paper, such as notes, drafts, etc.; pupils being shown specimens of those in actual use, with their indorsements.

Senior B.—Repetition of and drill continued in work of first year. Partnership; insurance; stock and bonds with reference to newspaper and Stock Exchange reports; taxes.

Business Colleges.—For the student who needs the higher commercial training, business and commercial colleges exist in many of the American cities. The business college is distinguished by the practical character of the instruction which it gives, the commercial office being a prominent feature of its work. As a rule, the business college is a day school, open to both sexes, of ages varying from 18 to 21, and the hours of attendance are from twenty-seven to thirty-eight weekly. The course rarely exceeds the year, and in some of the institutions lasts only six months. The business colleges generally provide for three classes of instruction—

(*a*) Preparatory.
(*b*) Senior.
(*c*) Actual business practice.

Higher Commercial Schools.—According to the latest report of the United States Bureau of Education, there are twenty-three Higher Commercial Schools in America, each of which is connected with either a university or a college. A short account of some of these schools, from Chapter XXV of the Report, will show the reasons for their establishment, and the scope of their teaching.

The Wharton School of Finance and Economy, Philadelphia.—It is generally admitted that the Wharton School of Finance and Economy of the University of Pennsylvania was the first institution to offer special courses of study for the higher education of business men. In founding the school in 1881, Mr. Wharton, of Philadelphia, expressed the desire that it should provide for (1) "An adequate education in the principles underlying successful civil government"; (2) "A training suitable for those who intend to engage in business or to undertake the management of property."

The course extends over four years, and leads to the degree of Bachelor of Science.

New York University, New York City.—The School of Commerce, Accounts, and Finance was established in the year 1900 "to train men for the higher duties of commercial life." The course of study extends through two years, and students completing the course receive the degree of Bachelor of Commercial Science. The curriculum includes:—Accounting, commerce, finance, commercial law, administration.

Dartmouth College, Hanover, N.H.—In 1900, Amos Tuck, a graduate of the college in 1862, founded the School of Administration and Finance with an endowment of $400,000. The school aims at training college graduates who prefer a business career. "The instruction offered is to prepare men to enter upon private banking, brokerage and investments, insurance, railroad service and water transportation, foreign trade, general mercantile or manufacturing businesses, journalism, consular service, or for active participation in municipal and civic affairs." The following is the scope of the courses of instruction offered:—Modern languages, advanced history, advanced economics, law and diplomacy, sociology and statistics, administration, accounting and auditing, business organisation and procedure, commerce, transportation, money and banking, public finance, corporation finance and securities, insurance, thesis.

University of Chicago.—The College of Commerce and Administration was established in 1898 "in response to the growing demand for a course of University instruction that should be adapted to the needs of students who desire to make university work more directly introductory to careers in business, law, diplomacy, administration, journalism, etc." The course of study extends through four years, and leads to the degree of Bachelor of Philosophy.

University of California, Berkeley.—The College of Commerce was opened in 1898, and "the curriculum is intended to afford an opportunity for the scientific study of commerce in all its relations, and for the higher education of business men and of the higher officers of the Civil Service." The undergraduate course of four years leads to the degree of Bachelor of Science, and "is devoted almost wholly to those studies of an elementary or a technical nature which are deemed most appropriate as a broad preparation for commercial life."

Drexel Institute, Philadelphia.—The Department of Commerce and Finance offers a liberal and thoroughly practical course of study, including two years' training in a knowledge of the world's industries and markets, the laws of trade and finance, and the mechanism and customs of business. In addition to this course of two years, there are three distinct office courses—private secretary course, book-keeping course, and stenography course—each occupying one year. A course is offered for teachers who wish to fit themselves for Commercial High School work.

Applicants for admission to any of the courses, except the commercial course for teachers, must pass satisfactory examinations in English grammar and composition, geography, arithmetic, and United States history, and must be at least 16 years of age. The diploma of High Schools of approved standing is accepted in place of an examination.

I.—COURSE IN COMMERCE AND FINANCE.

The aim of the course in commerce and finance is to give young men and young women thorough fundamental training for the activities of business, which include: (1) The production, manufacture, sale, and transportation of articles of commerce; (2) the management of stock companies and corporations; (3) the buying and selling of securities; (4) the importing and exporting of merchandise; (5) the borrowing and lending of money and credit; (6) the advertising of commercial concerns; (7) the keeping of business records; (8) a knowledge of the Spanish language.

The

The work of the course is divided into two years, as follows :—

Junior Year.

FIRST TERM.

English Language.—Composition ; letter-writing. American classics.

Commercial Arithmetic.—Weights and measures ; metric system ; trade standards and prices ; wages and pay rolls ; commercial interest and discount ; speed practice.

Business Customs.—Invoices ; commercial paper ; bills of lading and manifests ; vouchers.

Bookkeeping.—Principles and practice of single and double entry ; simple transactions ; business forms.

Penmanship.—A plain, rapid business hand.

Typewriting.—Word exercises ; study of mechanism of machine ; transcribing from rough draft.

Correspondence.—Mechanical arrangement and style of business letter ; exercises in condensing and expanding.

Commercial Geography.—Physical and mathematical geography in their relations to commerce. Commercial geography of the United States.

Spanish Language.—Elementary grammar, oral and written exercises ; vocabulary.

SECOND TERM.

English Language.—Grammatical principles ; diction. Selected classics.

Industrial Arithmetic.—Measurements ; builders' and contractors' bids and estimates ; scientific measurements ; manufacturers' and mechanics' estimates ; metric system.

Business Customs.—Securities ; collections ; discounts.

Bookkeeping.—Principles and practice of single and double entry in more complicated transactions. Shipments, consignments, and business forms.

Commercial Calculations.—Practical exercises for acquiring rapidity and accuracy of work.

Commercial Geography.—Industrial and economic geography of the United States, special attention being given to the new dependencies. Study of the world's commercial staples, raw and manufactured.

Spanish Language.—Grammar, oral and written exercises, vocabulary, reading, business letters, and business forms.

Penmanship.—Continued.

Typewriting.—Continued.

Correspondence.—Letters relating to contracts, purchases and sales, recommendations, introduction, credit ; circulars, telegrams.

Public Speaking.—One hour a week throughout the year.

Physical Training in the gymnasium twice a week throughout the year.

Senior Year.

FIRST TERM.

English Language.—Rhetorical principles ; synonyms ; essay writing.

Advanced Bookkeeping.—Importing and jobbing ; wholesale and retail ; manufacturing, real estate, joint stock companies, corporations, banking, etc. Introducing order book, cashbook, invoice and sales register, special column journal, bill book.

Banking and Finance.—Outlines of the history of banking and of the national banking system, State banks, saving banks, trust and financial companies ; foreign banking ; banking in its relations to foreign trade.

Commercial Arithmetic.—Financial problems involving partial payments ; buying and selling exchanges ; stocks and bonds ; equating of accounts ; adjusting of partnership, joint stock company, and corporation accounts.

Commercial Geography.—A comparative study of the commerce and industry of the great commercial nations of the world.

History of Commerce.—Outlines of the history of ancient, mediæval, and modern commerce, with special reference to the history of American commerce.

Civics.—Principles and practical operation of government in the United States.

Spanish Language.—Grammar, conversation, reading, correspondence.

Typewriting.—Arrangement of papers.

SECOND TERM.

English Language.—Paragraph—its sum and structure. Study of selected plays of Shakespeare.

Advanced Bookkeeping.—Continued.

Commercial Arithmetic.—Continued.

Banking and Finance.—Bank management, mechanism and practice of banking ; the clearing house ; currency reform.

Commercial Geography.—Continued. Special studies requiring independent research.

Mechanism of Commerce.—Boards of trade ; stock and produce exchanges ; transportation ; inter-state commerce ; warehousing ; importing and exporting ; duties ; exchange ; mercantile agencies.

Commercial Law.—Elementary principles of contracts and negotiable paper, and the leading principles which regulate the relations of the business man—principal and agent ; carriers ; commission merchants ; partnerships ; joint stock companies ; corporations.

Civics.—Principles and practical operation of government in the United States ; history, principles, and organisation of political parties ; civil service ; ballot systems ; representation systems ; municipal government.

Business Printing and Advertising.—Type and paper ; printers' estimates ; proof-reading ; business cards, circulars, and catalogues. Modern advertising, including mediums, rates, agencies.

Spanish Language.—Reading, conversation, correspondence.

Public Speaking.—One hour a week throughout the year.

Physical Training in the gymnasium twice a week throughout the year.

There are evening classes in the Spanish, French, and German languages, to which students of the department may be admitted on the payment of a fee of $6 for each language.

Students may elect to do special work in chemistry at the discretion of the director in charge.

The stereopticon is freely used in the class room as an aid in teaching the history and mechanism of commerce, commercial geography, and other subjects.

During the senior year, visits are made to some of the leading industrial and commercial establishments of Philadelphia, and systematic use is made of the Philadelphia commercial museums in the study of commercial geography.

Table

Table showing the distribution of time for the several subjects of instruction.

Junior Year.

Subject.	Hours per week.
English Language	2
Commercial and Industrial Arithmetic	4
Business Customs	1
Bookkeeping	5
Penmanship	2
Typewriting	2
Correspondence	1
Commercial Geography	2
Spanish Language	2
Public Speaking	1
Physical Training	2
Total	24

Senior Year.

Subject.	Hours per week.	
	First term.	Second term.
English Language	2	2
Bookkeeping	3	3
Banking and Finance	1	1
Commercial Arithmetic	3	3
Commercial Geography	2	2
History of Commerce	2	....
Mechanism of Commerce	....	2
Civics	2	2
Spanish Language	2	2
Commercial Law	....	2
Business Printing and Advertising	....	*1
Typewriting	2	....
Public Speaking	1	1
Physical Training	2	2
Total	22	23

*Part of the term.

The diploma of the institute is granted to students who complete the course in commerce and finance and pass the prescribed examinations.

II.—COMMERCIAL COURSE FOR TEACHERS.

In order to meet the growing demand for specially trained commercial teachers, the institute offers instruction to men and women who wish to equip themselves for entrance upon the new and widening field of commercial work in high schools and academies.

For admission to this course, the applicant must have had at least two years' experience in general teaching, or must have been graduated from a State normal school of approved standing.

Students who enter this course are given special consideration by the professors and instructors of the department, generous assistance being given in methods of teaching, the preparation of outlines and courses, and the bibliography of the several subjects.

The course occupies one year, divided into two terms, and includes the following subjects :—

English Language.—Rhetorical principles ; essay writing ; selected plays of Shakespeare.

Bookkeeping.—Principles and practice of single and double entry ; business forms ; importing and jobbing ; wholesale and retail ; manufacturing, real estate, joint stock companies ; corporations ; banking, etc. Introducing order book, cash book, invoice, and sales register, special column journal, bill book.

Commercial Arithmetic.—Financial problems involving partial payments ; buying and selling exchanges ; stocks and bonds ; equating of accounts ; adjusting of partnership, joint stock company, and corporation accounts.

Banking and Finance.—Outlines of the history of banking and of the national banking system ; State banks, savings banks, trust and financial companies ; foreign banking ; banking in its relations to foreign trade ; bank management, mechanism, and practice of banking ; the clearing house ; currency reform.

Commercial Geography.—Physical and mathematical geography in their relations to commerce ; industrial, commercial, and economic geography of the United States ; comparative study of the commerce and industry of the great commercial nations of the world ; special studies requiring independent research.

History of Commerce.—Outlines of the history of ancient, mediæval, and modern commerce, with special reference to the history of American commerce.

Commercial Law.—Elementary principles of contracts and negotiable paper, and the leading principles which regulate the relations of the business man—principal and agent ; carriers ; commission merchants ; partnerships ; joint stock companies ; corporations.

Mechanism of Commerce.—Boards of trade ; stock and produce exchanges ; transportation ; inter-state commerce ; warehousing ; importing and exporting ; duties ; exchange ; mercantile agencies.

Civics.—Principles and practical operation of government in the United States ; history, principles, and organisation of political parties ; civil service ; ballot systems ; representation system ; municipal government.

Stenography.—Theory of Pitman system ; special emphasis upon methods of teaching the subject.

Typewriting.—Word exercises ; study of leading typewriters ; transcribing from rough draft ; arrangement of papers ; instruction in duplicating processes ; letter press ; office practice.

Penmanship.—A plain, rapid business hand.

Should the student's time admit, the Spanish language may be added to the course.

Table of the distribution of time for the several subjects of instruction.

Subject.	Hours per week.	
	First term.	Second term
Bookkeeping	3	3
Commercial arithmetic	3	3
Commercial geography	3	3
History of commerce	2	0
Banking and finance	1	1
English language	2	2
Civics	2	2
Stenography	3	3
Typewriting	3	1
Commercial law	0	2
Mechanism of commerce	0	2
Penmanship	1	1
Total	23	23

The diploma of the institute is granted to students who complete the commercial course for teachers and prepare an acceptable thesis upon an assigned commercial topic.

III.—OFFICE COURSES.

Three distinct office courses are offered. These are thoroughly practical in character, and are adapted to prepare young men and young women for entering immediately upon the respective lines of employment to which the training leads.

Private Secretary Course.—This course has been organised to respond to applications that are made to the institute for clerks fitted to do work of a more general character and of a higher grade than that required in a purely business office. Applicants for admission must show by examination, or otherwise, that they are prepared to profit by the training given in this course.

The course occupies one year, divided into two terms, and includes the following subjects :—

Stenography.—First term : Theory of Pitman System ; daily drill in phonetics. Second term : Practice of the art by means of carefully graded dictation exercises, and daily transcript of notes.

Typewriting.—Word exercises ; study of leading typewriters ; transcribing from rough draft ; arrangement of papers ; instruction in duplicating processes ; letter press ; office practice.

English Language.—Rhetorical principles ; essay writing ; collection and arrangement of material ; criticism of manuscript ; English classics.

Spanish Language.—Grammar, oral and written exercises ; reading, correspondence, business letters and business forms.

Business Printing.—Type and paper ; printers' estimates ; proof-reading.

Accounts, Business Forms and Customs.—Elements of single and double entry bookkeeping ; invoices, commercial paper, vouchers, etc.

Correspondence.—Arrangement and style of business letters ; letters of recommendation, introduction, etc. ; circulars ; telegrams.

Penmanship.

Public Speaking.—One hour a week, for young men.

Physical Training in the gymnasium, twice a week.

Table of the distribution of time for the several subjects of instruction.

Subject.	Hours per week.
Stenography	9
Typewriting	5
English Language	2
Spanish Language	2
Accounts, Business Forms and Customs	1
Correspondence	1
Penmanship	1
Business Printing	*1
Physical Training	2
Total	24

* Part of second term.

Bookkeeping Course.—The object of this course is to prepare young men and young women for positions as bookkeepers. It occupies one year, divided into two terms, and includes the following subjects :—

Bookkeeping.—Single and double entry ; use of auxiliary books ; order books, cashbooks, invoice and sales register, bill book, special-column journal, etc.

Commercial Arithmetic.—Weights, measures ; metric system ; builders', manufacturers', mechanics' estimates ; partial payments ; exchanges, stocks, bonds, partnerships ; joint stock companies and corporations ; speed practice.

Business Forms and Customs.—Invoices, commercial paper, bills of lading and manifests ; vouchers.

English Language.—Composition ; letter writing ; grammatical principles. American classics.

Correspondence.—Arrangement and style of business letters ; letters of recommendation, introduction, etc. ; circulars ; telegrams.

Penmanship.—A plain, rapid, business hand.

Typewriting.—Word exercise ; mechanism of machine ; transcribing from rough drafts ; arrangement of papers.

Public Speaking.—One hour a week, for young men.

Physical Training.—In the gymnasium, twice a week.

Table

Table of the distribution of time for the several subjects of instruction.

Subject.	Hours per week.
Bookkeeping	8
Commercial arithmetic	5
Business forms and customs	1
English language	2
Correspondence	1
Penmanship	2
Typewriting	3
Public speaking	1
Physical training	2
Total	25

Stenography Course.—The aim of this course is to train young men and young women for positions as stenographers. There is a growing demand among business men for stenographers who can not only take down and typewrite correspondence, but who have a serviceable knowledge of good English and who are intelligently trained along general educational lines.

The course occupies one year, divided into two terms, and includes the following subjects :—

Stenography.—First term :—Theory of Pitman System ; daily drill in phonetics. Second term :—Practice of the art by means of carefully graded dictation exercises and daily transcript of notes.

Typewriting.—Word exercises ; study of leading typewriters ; transcribing from rough draft ; arrangement of papers. Instruction in duplicating processes ; letter press ; office practice.

English Language.—Composition ; letter-writing ; grammatical principles. Selected American or English poets.

Accounts, Business Forms, and Customs.—Elements of single and double entry bookkeeping ; invoices, commercial paper, vouchers, etc.

Correspondence.—Practice in writing business letters, orders, and telegrams.

Penmanship.

Public Speaking.—One hour a week, for young men.

Physical Training.—In the gymnasium, twice a week.

Table of the distribution of time for the several subjects of instruction.

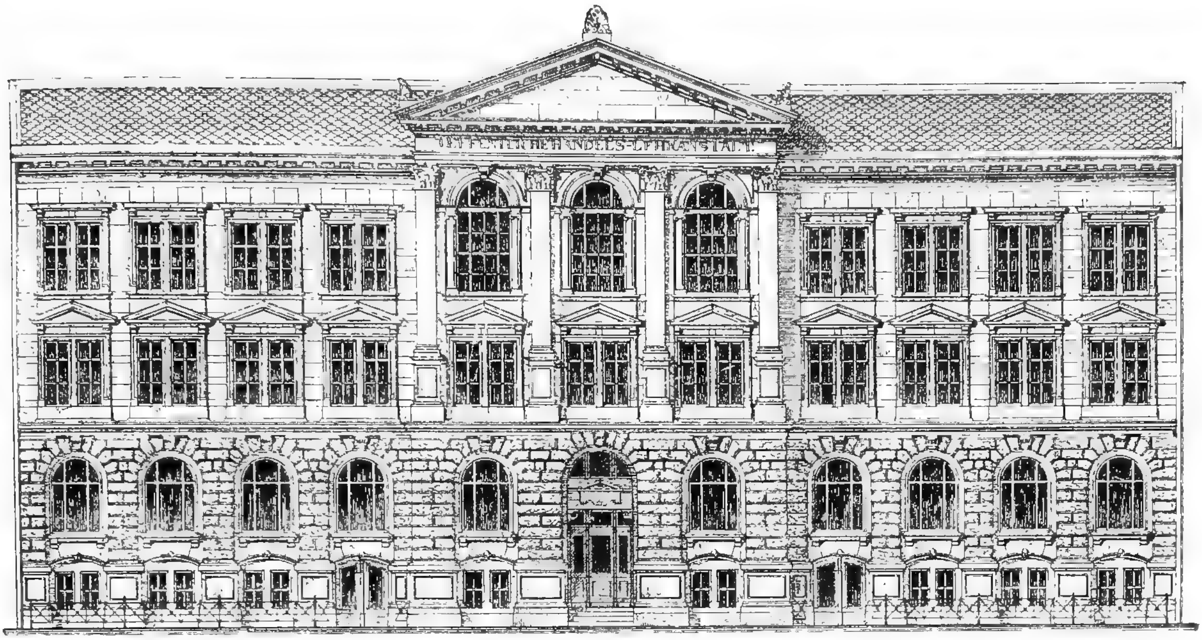
Subject.	Hours per week.
Stenography	9
Typewriting	5
English	2
Accounts, business forms, and customs	1
Correspondence	1
Penmanship	1
Physical training	2
Total	21

Certificates are granted to students who complete any one of the office courses and pass the prescribed examinations.

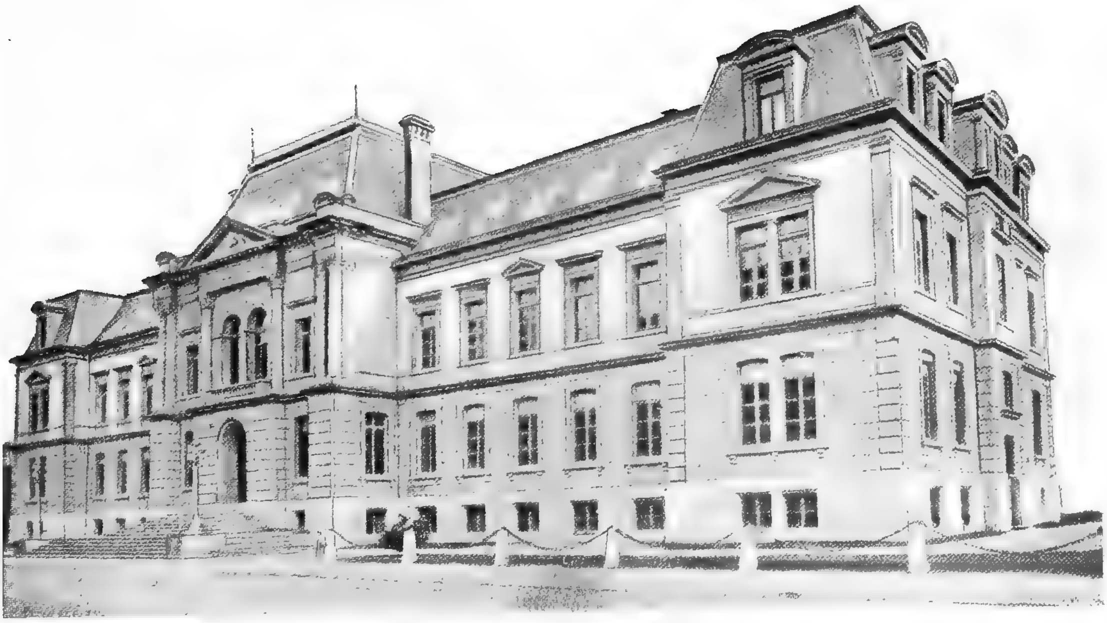
COMMERCIAL MUSEUM.

A beginning was made in 1895 toward the formation of a permanent commercial museum, and a large collection of raw and manufactured products has already been secured. The collection represents quite fully the following industrial products :—Flour, wool, petroleum, teas and coffees, sugar, cotton, copper, iron and steel, glass, tobacco, leather, rubber, paper, wood, carpet, linen, spices, aluminum, building stone, brick, and terra cotta. Additions are constantly being made, and the student who is looking forward to devoting his life to trade, shipping, or manufacturing, has opportunity, in connection with his academic work, to make a special study, from both a geographic and an economic standpoint, of the particular industry in which he is interested.

Sydney : William Applegate Gullick, Government Printer.—1905.

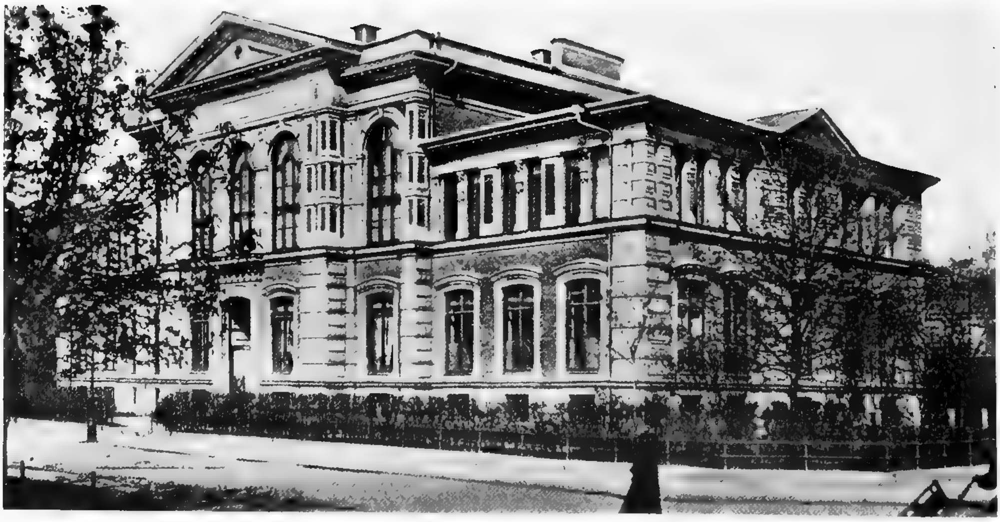


THE PUBLIC COMMERCE SCHOOL, LEIPZIG.



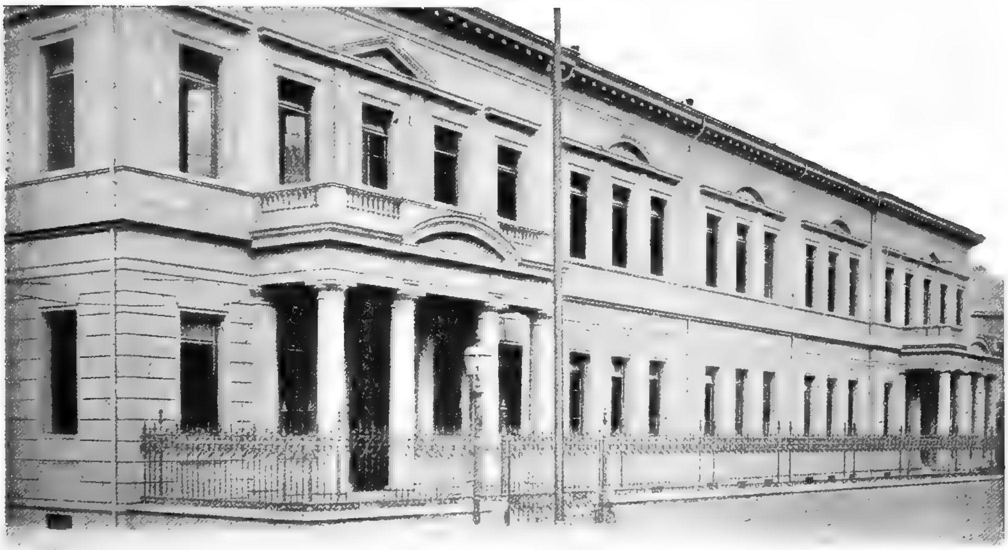
L'ACADÉMIE DE NEUCHÂTEL.

TECHNISCHE HOCHSCHULE, DRESDEN.



HANDELSINSTITUTET, GÖTEBORG (COMMERCIAL INSTITUTE OF GOTHENBURG, SWEDEN).

GYMNASIUM BONN.



A GYMNASIUM.

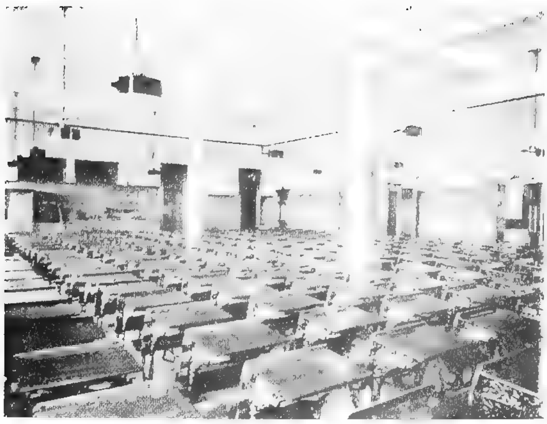
XÉNIE INSTITUTE, ST. PETERSBURG.

THE ASSEMBLY HALL SUPERB IN ITS PROPORTIONS, HIGH SCHOOL, SPRINGFIELD.

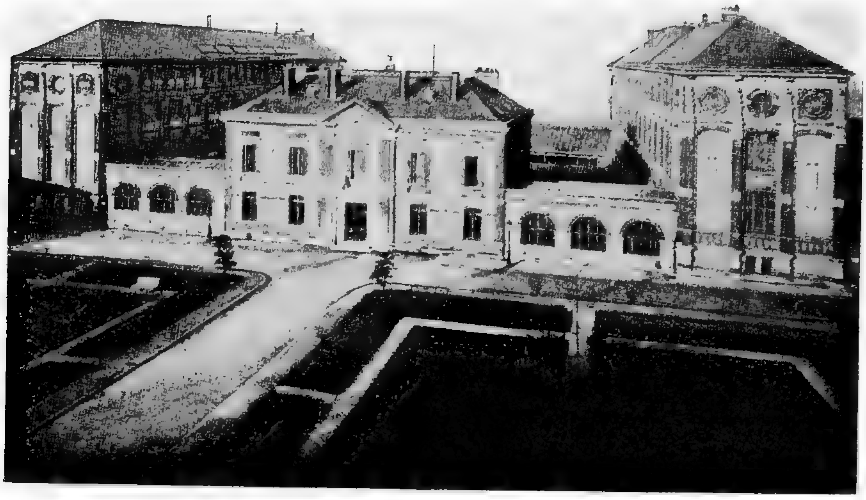
THE COCKBURN HIGHER GRADE SCHOOL, LEEDS ENGLAND.

ALLAN GLEN'S SCHOOL, GLASGOW, SCOTLAND.

WATERLOO ROAD COMMERCIAL EVENING SCHOOL,
MANCHESTER, ENGLAND.



TENTH GRADE ASSEMBLY ROOM, HIGH SCHOOL,
DETROIT.



ÉCOLE ESTIENNE.

ÉCOLE ARAGO.—FAÇADE.